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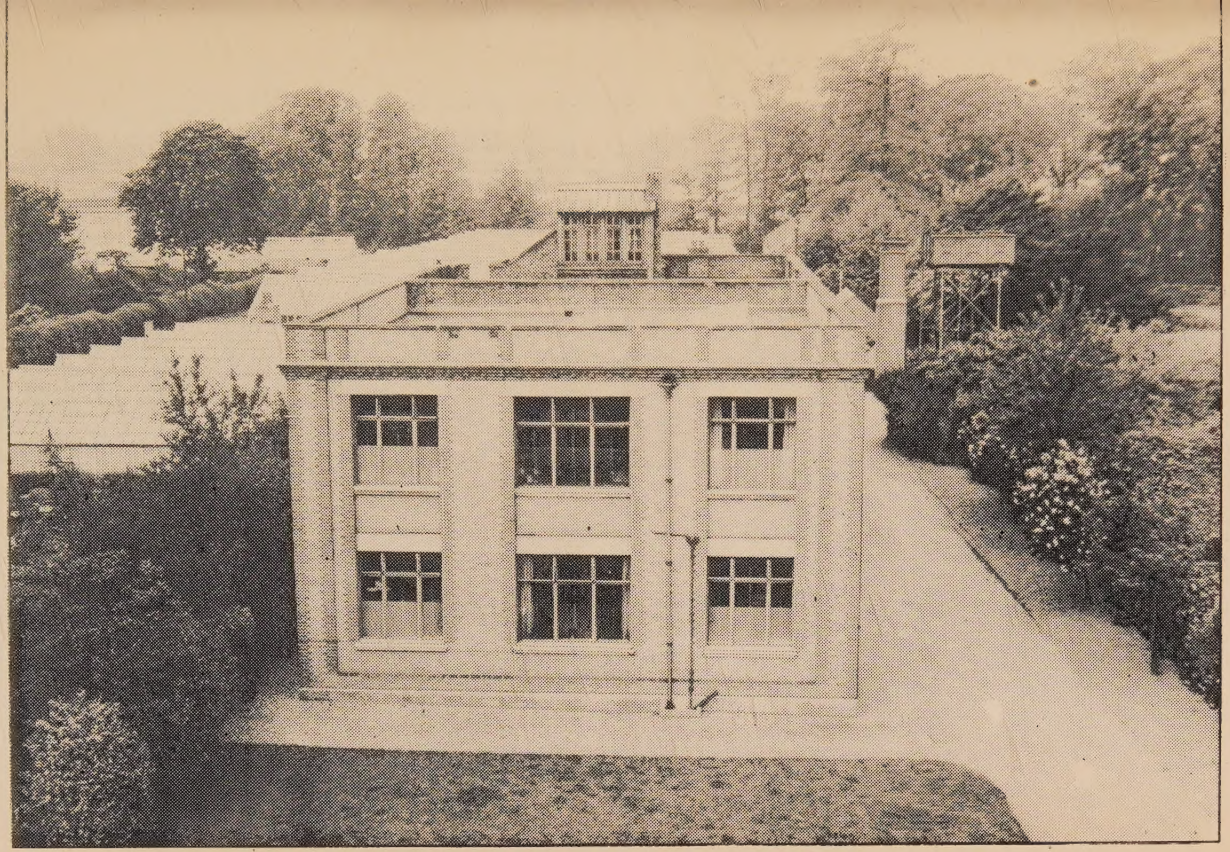

TABLE OF CONTENTS.

	Page
INTRODUCTION	9
DIRECTOR'S REPORT	14
1. EXPERIMENTAL RESULTS IN 1941 :	
1 Tomatoes	14
(a) Straw as vertical walls in the soil.	14
(b) Sulphate of potash versus muriate of potash	17
(c) Variety trials	17
(d) Tomatoes in cucumber houses	22
(e) Tomatoes grown outside in pots during the summer, and taken into glasshouses in September	24
(f) National Trials of outdoor tomatoes	25
2. LETTUCE.	
(a) Cheshunt Early Giant	31
(d) Cheshunt Early Ball...	31
2. ADVISORY WORK IN WARTIME.	
1. Worthing	33
2. Essex	34
3. Blackpool area	35
4. Somerset	37
5. Norfolk	39
6. Cheshire and North Wales	41
7. Bedfordshire	42
3. PLANT DISEASES.	
1. *Verticillium* and *Fusarium* wilts of the tomato	45
2. Virus diseases.	46
(a) The effect of lime and potash on the spotted wilt disease of the tomato	46 46
(b) The significance of stem stripes or streaks on the tomato	50
(c) Fruit losses associated with Mosaic infection in the tomato	52

TABLE OF CONTENTS *(continued)*.

Page

4. ANIMAL PESTS.

1. Trapping the tomato Moth 53
2. Red Spider Mite 56
3. Wireworm Investigations. 58
4. Root-knot eelworm 60
5. Notes on other pests 61
   (a) Ghost-Swift Moth 61
   (b) Green-fly 61
   (c) Thrips 62
6. Soil treatment with carbon di-sulphide, and formaldehyde-carbon di-sulphide mixtures for the control of wireworms 62

5. CHEMICAL PROBLEMS. 65

APPENDIX :

A. Publications 67
B. Manurial Treatments 73
C. Manurial Treatments 74
D. Cultural Operations 74

Diagram shewing arrangements of Experimental Plots in 1941.

Introduction.

ANOTHER year has passed under war-time conditions and the glasshouse industry continues to function as an important food producing section of the community. The Government has decided that more and more tomatoes must be grown to meet National requirements and less important crops have been reduced. Tomatoes in the summer and lettuce in the winter is the cropping programme most likely to supply the nation with health-giving vegetable foods.

The work of the Cheshunt Research Station has proceeded smoothly. Less attention has been given to long range research and more to the urgent problems which are affecting growers under present conditions.

The arrangements have been continued whereby members of Staff have stayed for a few weeks at a time in different parts of the country, visiting growers and becoming acquainted with local problems. Mr. E. R. Speyer spent a little more time in Northumberland studying the behaviour of the wireworm pest and conducting experiments on nurseries. His contacts with the provincial and county advisers have been most helpful. Dr. O. Owen was in Cheshire last June, and also visited a few growers in North Wales who had submitted special problems for investigation. Mr. P. H. Williams and Mr. A. A. Richards returned to Sussex in April and also spent a profitable time in the Blackpool area during the month of June. Mr. O. B. Orchard visited Norfolk in April and Somerset in July and September. Mr. W. H. Read visited Bedfordshire in May and further assisted the War Agricultural Executive Committee of Essex from June to December.

The manner in which the members of the Cheshunt Staff have been welcomed by county officers and growers alike has been most encouraging. It has obviously increased the usefulness of the Station by personal contact with a very large number of growers and has strengthened co-operation with the counties concerned.

A National trial of outdoor tomatoes was organised for the first time this year. Thirty-three counties in England and seven in Wales took part. The horticultural advisers contributed greatly to the success of these trials.

Current Investigations.

The experiments commenced in 1940, to study the relative effects of muriate and sulphate of potash, have been continued. In 1940 a significantly lower yield was obtained where muriate was used, but no injurious foliage or other symptoms could be detected, In 1941 there has been neither a reduction in yield nor any observable injurious effects on the plant itself.

Several experiments were designed to test the effect of different arrangements of straw walls in the soil and different weights of straw in a given area as a means of introducing water into the subsoil during the summer. Once more the results proved the beneficial effect of applying straw in this manner and indicated that the amount of straw used is important.

Tomatoes were grown for the second year in the cucumber houses, by the method which is now advised generally for the cultivation of tomatoes in small houses, namely, by paying particular attention to the two back rows trained under and tied to the roof wires. An average yield of 41.3 tons per acre was obtained, and the experiment proved once again the relation between crop yield and the amount of available light. The yield gradually increased from 35.6 tons per acre to 44.5 tons per acre as the amount of shade provided by the laboratory buildings became less.

Trials with tomato varieties resistant to leaf mould, *Cladosporium fulvum*, proved that the Canadian variety, Vetomold, was immune under the conditions of the experiment. Two Danish varieties, Virum A. and B., showed some resistance up to the middle July, but became badly infected later. In the ordinary variety trials high yields were obtained from a number of selections obtained by crossing Potentate with Kondine Red in 1934. One variety, Watson's Best of All, proved outstanding in the weight of fruit which it produced on the tops. It will be submitted to further trials in 1942. A small trial of outdoor tomatoes was conducted on the only piece of available land.

Cheshunt Early Giant lettuce was grown as a winter crop in the glasshouses. Two new varieties, obtained by crossing Cheshunt Early Giant and Green Frame, were also tried on a small scale. These may prove to mature quicker than Cheshunt Early Giant and be more suitable both on steam sterilized soil and on rich soil such as that produced by levelling cucumber beds at the end of the season. They are being tested on a larger scale during the winter of 1941—42.

Cheshunt Early Ball again proved its value as a high-class frame lettuce.

Trials were made with a number of glass substitute materials, in frames, using lettuce as the test crop.

Experiments carried out at the Research Station and upon commercial nurseries proved that cane molasses was a most efficient substitute for treacle in the trapping jars for Tomato moths. Malt Extract in solid powdered form, more convenient to handle than treacle or molasses, was later found to be fully as attractive to the moths as either of the latter.

It has been concluded that immunisation of tomato plants against attack by the Red Spider mite by means of selenium is impracticable.

Observations upon the habits of *Agriotes* larvæ in relation to lettuce and tomato crops suggest that practical methods of control might result from a study of their periodic feeding.

In loam soils wireworms were found in large numbers to a depth of 2 feet 8 inches during the winter months, both in heated and unheated houses: they appear to descend to such depths in order to obtain moisture. It was proved experimentally that wireworms can penetrate deeply into and that they can live in the heaviest and stickiest clay soils.

Experiments upon tomato plants growing in soils watered with solutions of potassium iodide suggest that more concentrated solutions are necessary to obtain control of the Root-Knot Eelworm upon heavier than upon lighter soils.

Severe attacks upon the stems of chrysanthemum plants by the Ghost Swift Moth caterpillar have been recorded. Incorporation of naphthalene at the rate of 1½ ounces to the hundredweight of potting soil was sufficient to kill caterpillars contained in it.

Aphids which attack tomato and lettuce plants have been studied, to determine which species are likely to pass from one to another, and to both from other glass house plants.

Certain Californian varieties of tomato, said to be resistant to *Fusarium* and *Verticillium* wilts, have been tested for resistance under English conditions. Two of them were significantly more resistant than Ailsa Craig, Potentate, and Manx Marvel. The quality of the fruit was poor although some plants were better than others. Further selection will be necessary before they can be used in this country.

Outbreaks of Spotted Wilt virus disease were severe in 1941 and an attempt has been made to correlate soil conditions with the incidence and severity of the disease.

Experiments have shown that varying the lime content of a medium loam potting soil induced a wide range of disease symptoms, omission of lime tending to increase the rate of appearance of the disease. An indication was obtained that liming may tend to produce plants rather less susceptible to artificial infection with this virus.

Recent work has shewn that the so-called Streak disease of the tomato should more properly be regarded as a symptom of a cultural disorder rather than as an index of a specific infection. The commonest cause of Streak lesions is undoubtedly the association of a tomato mosaic virus infection with faulty cultural conditions.

Continuation of the work on mosaic infection of tomato plants has emphasized the close relation which exists between the loss of fruit and the partial failure of the flowers to set fruit. With one strain of tomato mosaic it has been possible to reduce the loss of fruit occasioned by early infection from 22.3% in 1940 to 13.4% in 1941, primarily by careful attention to cultural methods.

A good deal of the war-time work of the general chemical department has been of an advisory nature. There was some reduction in the number of soil samples analysed in comparison with previous years, but the number of samples of other materials continues to increase. These have been mainly fertilisers and fertiliser substitutes, but quite a number of peat samples from various parts of the country have been submitted for examination. As time has permitted experiments have been continued in an attempt to devise some satisfactory method for the evaluation of peat for horticultural purposes, The range of fertilisers and substitute materials has been a wide one. With few exceptions most of the samples were reasonable in price and were considered suitable for use under glass.

Last year it was concluded that vitamin B_1 had but little effect on plants grown in a standard compost. This was confirmed in experiments on tomatoes during the past season.

DIRECTOR'S REPORT.

1. Experimental Results of 1941.

1. Tomatoes.

The practice of grading the tomato fruits from the experimental plots, adopted in 1921, was continued :—

A.—"Pinks" number 5 to 7 and "Pink and White" 8 to 10 to the lb. These are the best quality of fruit in size, shape and colour; "Pinks" being slightly larger than "Pink and Whites."

B.—"Whites." These fruits are of good colour but smaller than "Pink and White."

C.—"Blues." This grade consists of fruits of good colour but larger and more irregular in shape than Grade A.

D.—"Roughs." Small mis-shapen fruits about the size of cherries.

E.—Blotchy fruits which ripen irregularly.

F.—Fruits shewing Blossom End Rot.

G.—Fruits shewing the lesions of Streak Disease.

H.—Fruits shewing "Green Back."

(a) Houses 3—4 and 7—9. Straw as vertical walls in the soil.

The application of wheat and oat straw to the soil in glasshouses so that it remains in almost vertical walls was first recommended in 1933, and since then fuller details have been published in Circular No. 14, which is available to all members.

Applied in this way it improves the condition of the soil atmosphere by permitting gases formed by chemical and biological processes to escape more easily from the soil and air to diffuse into it. It opens up the soil, provides suitable food material for the soil bacteria and increases the humus content. It makes many clay soils lighter and prevents an excess of water from remaining in the surface layers, as it does so frequently in soils of this type. It also changes the condition in which nitrogen exists in the soil, and when the

land is not abundantly supplied with nitrogen. symptoms of nitrogen starvation may appear in the crop following; this can be corrected easily by top-dressing. The walls of straw can also be used as channels down which water can be poured into the subsoil, without applying too much water to the top spit.

Growers should, however, regard the process as one for improving the physical state and also cleaning the soil to some extent, not as introducing a fertilizer, for in most cases the normal manurial treatment must be applied in addition to the straw.

The experiments in Houses 3 and 4 were designed to determine if there was any advantage in allowing three walls of straw to every two rows of tomato plants instead of two walls of straw, the straw being pushed into the soil by the "V" shaped cut method (see Circular No. 14). A comparison was also made between this method of introducing the straw and the original method which involved bastard trenching.

The results detailed in Table 1 shew the beneficial effect of applying straw in this manner and also indicates that the amount of straw is important. Two walls of straw to every two rows of plants, one on each side of the double row, gave an average yield of 41 tons per acre, while the addition of a third wall of straw in the narrow row increased the average yield to 47 tons per acre.

In Houses 7—9 an attempt was made to determine how the thickness of the walls of straw affected the yield. This was done by weighing the straw before pushing it into the soil, and plots were arranged in which 8 ounces, 12 ounces, and 16 ounces of straw respectively were used to the foot run of straw wall. Three walls of straw were allowed to every two rows of plants.

Unfortunately the crop yield did not shew a positive result and therefore in the interests of economy the figures are not detailed. The average of twelve plots was 43·89 tons per acre where 8 ounces of straw were used per foot run of wall, 43·60 for 12 ounces, and 44·71 in the case of 16 ounces.

The chief use of the straw walls in this experiment was to convey water into the sub-soil. The plots were small (thirty-two in a house 100 feet long by 28 feet wide) and the sub-soil is of a gravelly nature. It seems safe to assume that the water poured down the walls of straw provided a common supply for all the plots and so neutralised the effect of the experiment.

Table 1.

House	Plot	Treatment	Crop yield in lbs. per plant						Total per acre	Average tons per acre	Per cent blotchy fruit
			June	July	Aug.	Sept.	Oct.	Total			
3	6	No straw	0·70	2·00	0·71	0·87	0·88	5·16	39·21	39·34	7·42
	7	,, ,, ...	0·72	2·03	0·70	0·86	0·60	4·91	37·32		11·28
4	5	,, ,, ...	1·48	1·64	1·02	0·98	0·34	5·46	41·49		6·22
3	1	Straw introduced by bastard trenching	0·63	1·85	0·92	1·23	0·53	5·16	39·22	41·67	8·13
	4	,, ,, ,, ,, ,,	0·61	1·74	1·22	0·89	0·92	5·38	40·89		6·70
4	8	,, ,, ,, ,, ,,	1·55	1·44	1·17	1·02	0·73	5·91	44·91		3·71
3	3	Two walls of straw to 2 rows of plants. Straw pushed in	0·44	2·10	1·12	1·02	1·07	5·75	43·70	41·06	6·77
	8	,, ,, ,, ,, ,,	0·90	1·74	0·82	1·06	0·71	5·23	39·75		7·27
4	6	,, ,, ,, ,, ,,	1·25	1·57	1·02	0·96	0·48	5·28	38·73		5·67
3	2	Three walls of straw to 2 rows of plants. Straw pushed in	0·39	2·35	1·70	1·03	0·85	6·32	48·03	47·11	7·29
	5	,, ,, ,, ,, ,,	0·73	2·31	1·21	0·87	0·78	5·90	44·84		8·99
4	7	,, ,, ,, ,, ,,	1·41	1·42	1·96	0·88	0·84	6·51	49·47		3·46

It is suggested, however, that 12 ounces of straw per foot run of wall is the approximate average at which to aim, for this quantity of straw produced a sufficiently wide wall to take the water required and remained in good condition far into the season. Eight ounces of straw per foot run seemed to be too little and 16 ounces were probably wasteful.

When the straw is introduced into the soil to a depth of 10 inches, 1 lb. of straw per foot run requires 8 tons of straw per acre, using two walls of straw to each double row of plants, if a third wall is placed in the narrow row, the amount used is 12 tons per acre.

(b) Houses 7—9. Sulphate of potash versus muriate of potash,

The experiment started in 1940 was continued, the muriate and sulphate of potash being applied to the same plots respectively as last year. The results given in Table 2 shew no appreciable difference in yield between the two, and despite careful observation through the season no adverse symptoms could be detected at any time as the result of applying muriate of potash. The experiment will be continued.

(c) Houses 1 and 2. Variety trials.

The variety trials included the ordinary commercial varieties in House 1, and those resistant to tomato leaf mould (*Cladosporium fulvum*) in House 2.

Of the ordinary varieties, one strain obtained by crossing Potentate with Kondine Red gave the highest yield. Carrick, Holmes "Beatall," and Watson's "Best of All" cropped heavier than Potentate, Comet, and other varieties tested. The yields per acre were as follows:—

Potentate x Kondine Red	...	...	47·65	tons	per	acre.
Carrick	...	...	...	...	44·69	,,	,,	,,
Holmes "Beatall"	...	...	...	41·12	,,	,,	,,
Watson's "Best of All"	...	...	41·04	,,	,,	,,
Potentate	...	..	...	...	38·00	,,	,,	,,
Comet	...	...	...	...	37·62	,,	,,	,,
Essex Wonder	...	...	...	37·60	,,	,,	,,
Tuckswood	...	...	...	...	35·34	,,	,,	,,

Carrick is a Sunrise type resembling Ailsa Craig to some extent, but producing a distinctly heavier top crop than the average strains of Ailsa Craig in cultivation to-day. It is a variety well worth a trial on commercial nurseries. Watson's "Best of All" comes from Scotland. It is a cross between

Table 2.

House	Plot	Treatment	Crop yield in lbs. per plant						Total tons per acre	Average tons per acre			Per cent blotchy fruit
			June	July	Aug.	Sept.	Oct.	Total					
7	1	Potash as sulphate	0·57	1·59	1·16	1·11	0·40	4·83	36·71				2·90
	2	,, ,,	0·74	1·76	1·10	1·32	0·31	5·23	39·75				4·40
	3	,, ,,	0·76	1·61	1·30	1·27	0·15	5·09	38·69				4·91
	4	,, ,,	0·87	1·48	1·41	0·92	0·34	5·02	38·18				4·18
	9	,, ,,	0·48	1·70	1·79	1·63	0·74	6·34	48·18				5·52
	10	,, ,,	0·59	1·55	1·39	1·25	0·35	5·13	38·99				4·48
	11	,, ,,	0·73	1·84	1·31	1·12	0·28	5·28	40·13				3·19
	12	,, ,,	0·75	1·91	1·11	1·31	0·34	5·42	41·19				4·80
8	5	,, ,,	0·68	2·14	1·50	1·41	0·54	6·27	47·66				4·47
	6	,, ,,	0·51	2·07	1·43	1·36	0·49	5·86	44·53				2·90
	7	,, ,,	0·37	2·29	1·38	1·66	0·71	6·41	48·71				6·24
	8	,, ,,	0·18	2·09	1·96	1·66	0·64	6·53	49·63				6·28
	13	,, ,,	0·49	1·92	1·75	1·36	0·80	6·32	48·03				5·22
	14	,, ,,	0·46	2·01	1·47	1·54	0·68	6·16	46·82				3·90
	15	,, ,,	0·51	1·82	1·62	1·41	0·55	5·91	44·93				3·89
	16	,, ,,	0·59	1·36	1·59	1·43	0·74	5·71	43·40				4·91
9	9	,, ,,	0·06	1·96	2·00	1·39	1·08	6·49	49·33				3·28
	10	,, ,,	0·10	2·05	2·01	1·27	1·04	6·47	49·16				3·25
	11	,, ,,	0·12	1·97	1·92	1·20	0·85	6·06	46·06				3·80
	12	,, ,,	0·21	2·15	1·87	1·46	0·84	6·53	49·62				3·37
	13	,, ,,	0·14	1·97	1·60	1·23	0·66	5·60	42·57				4·11
	14	,, ,,	0·14	2·04	1·92	1·29	0·89	6·28	47·72				2·88
	15	,, ,,	0·19	1·89	2·11	1·43	0·85	6·47	49·16				3·26
	16	,, ,,	0·21	1·76	1·72	1·32	0·79	5·80	44·08				4·14

Table 2 *(continued).*

House	Plot	Treatment	Crop yield in lbs. per plant						Total tons per acre	Average tons per acre			Per cent blotchy fruit
			June	July	Aug.	Sept.	Oct.	Total					
7	5	Potash as muriate	0·90	1·79	1·58	1·60	0·47	6·34	48·19				3·94
	6	,, ,,	0·55	1·41	1·42	1·23	0·45	5·06	38·46				2·37
	7	,, ,,	0·40	1·93	1·54	1·68	0·58	6·13	46·59				6·04
	8	,, ,,	0·44	1·18	1·40	1·82	0·91	5·75	43·70				2·44
	13	,, ,,	0·80	1·76	1·28	1·35	0·38	5·57	42·33		41·81		4·13
	14	,, ,,	0·74	1·73	1·03	1·43	0·24	5·17	39·28				3·29
	15	,, ,,	0·63	1·55	1·26	1·11	0·31	4·86	36·94				4·10
	16	,, ,,	0·55	1·54	1·33	1·17	0·54	5·13	38·99				4·50
8	1	,, ,,	0·56	1·52	1·36	1·10	0·59	5·13	38·99				5·07
	2	,, ,,	0·78	1·75	1·43	1·52	0·41	5·89	44·76				3·56
	3	,, ,,	0·41	1·69	1·14	0·66	0·18	4·08	30·99				2·94
	4	,, ,,	0·55	1·96	1·08	1·29	0·47	5·35	40·65				3·55
	9	,, ,,	0·27	1·92	1·84	1·71	0·77	6·51	49·48		43·03		2·31
	10	,, ,,	0·45	1·96	1·57	1·45	0·84	6·27	47·65				4·78
	11	,, ,,	0·41	2·01	1·65	1·46	0·88	6·41	48·71				3·59
	12	,, ,,	0·41	1·88	1·42	1·22	0·73	5·66	43·01				4·04
9	1	,, ,,	0·24	1·81	1·86	1·26	0·78	5·95	45·21				2·52
	2	,, ,,	0·18	1·73	1·92	1·12	0·95	5·90	44·83				2·03
	3	,, ,,	0·23	1·96	1·84	1·04	0·72	5·79	43·99				3·11
	4	,, ,,	0·21	2·09	1·91	1·18	0·94	6·33	48·11				2·84
	5	,, ,,	0·27	2·08	1·91	1·19	0·78	6·23	47·34				3·05
	6	,, ,,	0·23	2·25	1·97	1·24	0·96	6·65	50·55				3·46
	7	,, ,,	0·31	2·00	1·75	1·06	0·91	5·85	44·47				3·59
	8	,, ,,	0·09	2·20	1·88	1·34	0·10	5·61	42·65				4·46

Aldouri seedling and Ailsa Craig. An average weight of fruit is borne by the lowest five trusses, but the development of the tops was outstanding in the 1941 trials, and further investigations of this variety are in progress.

In the trial of leaf mould resistant varieties were included the Canadian variety Vetomold, two Danish varieties, Virum A and Virum B, and the Cheshunt variety, Leaf Mould Resister No. 1.

Vetomold proved immune to attack by *Cladosporium fulvum* and produced an average yield of 36·8 tons per acre. Neither Virum A nor Virum B were immune and their resistance was variable. Some plants shewed a high resistance while others were as susceptible as many of the ordinary commercial varieties.

Leaf Mould Resister No. 1 proved highly resistant, but the crop was not so heavy as that from Vetomold.

The average yields were as follows:—

Virum B	37·31 tons per acre.
Vetomold	36·87 „ „ „
Virum A	35·65 „ „ „
Leaf Mould Resister No. 1	33·64 „ „ „

The history and behaviour of Vetomold is interesting and well worth recording.

The Ontario Department of Agriculture announced in 1939 the introduction of a new leaf mould resisting variety called "Vetomold," which had been developed by Dr. A. N. Langford as a comparative project between the Departments of Botany and Biology of the University of Toronto and the Ontario Horticultural Experiment Station, Vineland.

Seeds of "Vetomold" were first sent to the Cheshunt Research Station by Dr. C. J. Robb (Vineland) in July, 1939. They were distributed for trial to a few selected growers in 1940, and the reports received at the end of the season were most promising. In every case the plants were free from leaf mould and, although there was some criticism regarding the shape of the fruit and the weight of crop, it was obvious that a real advance had been made. On the nursery of Messrs. G. & E. Hodges, Ashington, Sussex, the results were quite outstanding. One house was planted with "Vetomold," the remainder with ordinary commercial varieties. "Vetomold" alone remained clean and healthy until the plants were removed in November. The crop was heavy and the fruit excellent in shape and quality. Two boxes packed on the

nursery in August were taken to Cheshunt and when opened three weeks later could have been sent to market with freshly-picked fruit, so perfect was their condition.

In 1940 Dr. Langford sent a number of new strains for trial, and both he and Dr. Robb offered to send seeds of "Vetomold" to this country as their contribution to our war effort. It was good to know that our colleagues in Canada were so anxious to help the growers of this country in their struggles to increase the output of tomatoes and the offer was accepted gratefully. This seed, and a further supply taken from the 1940 crops at Cheshunt and Ashington, was divided up into small trial packets and sent to ninety-five growers all over the country. So during 1941 "Vetomold" has been submitted to exacting trials both in glasshouses and in the open.

"Vetomold" is a hybrid of the red currant tomato *Lycopersicon pimpinelli-folium* and Potentate, of the strain grown at the Cheshunt Research Station. In habit it resembles Potentate fairly closely. The leaves are spaced a little farther apart and, while they are drooping in habit, they spread a little more than in Potentate. They are also slightly larger, darker, more shiny and tougher. Trusses of fruit may either be single or double, bearing on an average seven fruits each. The fruit is large, fleshy, and slightly flat to round, containing two, three, or more "cells." The calyx is small, the sepals being incurved towards the stalk. "Vetomold" is definitely more robust than Potentate, and does not shew the same tendency to weaken after the fifth truss. The mid and late season fruits are often superior in quality to that of the first four trusses.

Reports on this year's trials have not yet been received from all growers, which is not surprising in view of present difficulties, but we hope that those who have not yet sent their reports will do so as soon as they can.

Speaking generally, however, growers are well pleased with this variety, and all agree that it is immune to attack by *C. fulvum*. Several have written enthusiastically regarding its future. Most growers are satisfied with the weight of crop produced, but a few have criticised the shape, size, and flavour of the fruit.

"Vetomold" has done well as an outdoor crop in some parts of the country, and Mr. W. H. Young, Lancing, Sussex, has observed some resistance to the potato blight fungus, ***Phytophthora infestans.***

These trials suggest, therefore, that "Vetomold" is immune from attack by *Cladosporium fulvum* in this country, and that under suitable conditions it can produce a heavy crop of good quality fruit. Where there has been any suggestion of poor setting, coarseness, and poor quality, it seems reasonable to assume that the conditions under which it has been grown and the method of cultivation have not been suitable for this variety. In our opinion it is a triumph in plant breeding and is well worthy of trial on any nursery where leaf mould is serious, especially as a late or second crop.

(d) Tomatoes in cucumber houses.

At the beginning of 1940 the Government decided that cucumbers were less important than tomatoes and therefore the cucumber houses at the Station were turned over to the cultivation of tomatoes for the duration of the war. Questions of variety, method of planting and cultivation details had already been studied on a small scale, and the "turn over" seemed to offer reasonable prospects of producing a satisfactory crop. The yield obtained in 1940 averaged 47·6 tons per acre, and during the less favourable summer of 1941 it was 41·3 tons per acre. Recent cropping orders have made it compulsory for tomatoes to be grown in small houses, previouly used for cucumbers, pot plants, bedding stuff, etc., and therefore a discussion of the method most likely to prove successful seems desirable.

For small houses it is important to choose a short-jointed variety which produces large fleshy fruit. Potentate is one of the best varieties for this purpose. It enjoys the rich soil and warm, moist conditions of cucumber houses, and indeed it often does much better in small houses than in the larger houses of the tomato and carnation type.

The first essential process of cultivation is winter flooding to ensure that the second spit is well wetted before planting. When preparing the soil, the previous year's cucumber beds should be dug into the top spit, after skimming off the top two or three inches. If the old beds have been taken out already, the soil should be enriched by means of old cucumber soil, old mushroom beds, or good strawy horse manure. Thirty to 40 tons per acre of the first two or half that quantity of horse manure will be sufficient. If there is time to sterilize with formaldehyde so much the better. The best tomato fertiliser available under present conditions should be forked into the top 8 inches of soil at the rate of 6 ounces per sq. yd. and, if

available, 2 ounces per sq. yd. of the standard ration of sulphate of potash. This will absorb about 5 cwts. of the 8 cwts. per acre which has been allocated to tomato growers and the remaining 3 cwts. can be retained for top-dressing purposes.

The method of planting and subsequent treatment of the growth is important. In a house 13 feet wide three rows of plants running lengthwise should be planted on either side of the central path. These rows should be 14 inches apart, and the plants spaced 18 inches and 27 inches apart alternately, so that when planting is finished the working paths run across the house. In the back rows an additional plant is planted in the centre of each path. The two rows nearest the path should be "stopped" at five trusses and the next two at four trusses. The two back rows are not "stopped" but allowed to cover the wires. As soon as the roof wires are reached side shoots should be permitted to grow until they have produced a truss and then stopped at the second leaf beyond it. This process is continued throughout the season. All main and side shoots should be tied in neatly to cover the wires uniformly. If this task is well done and the plants kept in good condition the reward will be a magnificent roof crop crowded with fruit that will continue well into November. A prettier sight it is difficult to imagine.

When the four centre rows (two on either side of the path) have yielded their crop of four and five trusses they should be removed to allow the roof crop to have as much air and light as possible. When this has been done it is a good plan to prick up the soil lightly to a depth of 2—3 inches and apply a light mulch of horse manure.

Wide experience of the cultivation of tomatoes in small houses has shewn that the practice of obtaining the bulk of the crop from the two rows of plants trained over the roof wires produces heavier crops than any other.

Potentate is a variety which responds well to treatment with nitrogenous fertilisers throughout the growing season, especially dried blood. The following mixture suits it admirably if the ingredients are available:—

1 part sulphate of ammonia.
1 part nitrate of potash.
3 parts superphosphate.
5 parts dried blood.

Used at the rate of 2 ounces per sq. yd. the first dressing can be given as early as six weeks after planting where grow-

ing the variety Potentate, and, in any case, it is unwise to delay the treatment too long. Even when grown in old cucumber beds this variety will require ample feeding.

If this mixture cannot be obtained it can be replaced by mixing equal parts of a good tomato top-dressing mixture and dried blood. The rate of application is 2 ounces per sq. yd. at intervals of six weeks or less if the crop requires it.

Overhead damping should be applied systematically. This variety thrives in a moist atmosphere, and is among the types most resistant to leaf mould (*Cladosporium fulvum*). Potentate also favours warm conditions. The night temperature should be kept at 60°—65° F., and correspondingly higher during the daytime. Growth should be steady until the first flower opens, but after this temperature and atmospheric humidity should be controlled so that the plants are kept growing freely until the fourth truss has set. This type of growth produces heavier and better shaped fruit from the bottom trusses than can be obtained from plants of harder growth.

Thus, low temperatures and dry atmospheric conditions are both unfavourable for this variety and must be avoided. Probably this explains why heavier crops of Potentate are frequently produced in small houses in which suitable conditions are more readily obtained than in normal tomato houses. It should also be noted that Potentate is a very suitable variety for early work.

If growers will adopt this method of cultivating this variety in small houses they will have no difficulty in obtaining successful crops of tomatoes.

(e) Tomatoes grown outside in pots during the summer and taken into glasshouses in September,

A useful crop of tomatoes can be picked from October to the beginning of January by growing the plants in the open during the summer and taking them indoors at the end of September to ripen the fruit. For this purpose seeds are sown in seedboxes about the middle of May, potted on into size 60 pots and finally into 9 or 10 inch pots standing out-of-doors in a sheltered position. Fleshy fruited varieties should be selected of which Potentate, Vetomold, Tuckswood, and Kondine Red have proved successful. From seed sowing until the plants are well established in 60 pots, the plants are kept in a heated glasshouse. Then they are hardened off in a cold house prior to planting in the large pots outside. These should be filled with a good compost made from five parts good turfy loam (to which the necessary lime has been added)

and one part of strawy horse manure. A 60 pot each of hoof and horn, bone meal, and sulphate of potash is added to each barrow-load of compost. If this is unobtainable, a 32 pot of tomato base fertiliser should be used. When filling the pots a layer of sand, gravel, or washed ashes should be put in the bottom to assist drainage.

In districts like the Lea Valley potting into the large pots must be finished by 7th July otherwise there will not be time to set four good trusses before the end of September. The pots should be stood out in double rows, 14 inches from plant to plant in the rows, and 18 inches between the rows. Paths 2 feet 6 inches should be arranged between the double rows. The plants must be staked, tied, fed, watered and generally attended in the best possible way. Growth is naturally harder and slower than under glass, therefore the plants need more nitrogen. A mixture consisting of half dried blood and half of a good tomato top-dressing is a useful fertiliser for this work, as are mixtures containing fish and meat meals.

The plants must be protected from late blight, *Phytophthora infestans*, by spraying every fourteen or twenty-one days. Before the late September frosts are due, the plants should be taken in the glasshouses and spaced as in ordinary glasshouse culture. Kept at a night temperature of 50°F., and given ample ventilation, the fruit will ripen slowly and in good condition.

(f) National trials of outdoor tomatoes.

This, the first of a series of trials with outdoor grown tomatoes, was organised throughout England and Wales. The County Staffs co-operated by selecting the centres and arranging the trials in their own counties.

Variety trials.

The variety trial consisting of a Latin square arrangement of twenty-five plots was laid down at thirty-three centres in England and seven in Wales.

Each plot was 30 feet long and 15 feet wide and contained 100 plants, set out 18 inches apart in single rows, the rows being 3 feet apart. The object of the trials was to determine the areas most suitable for outdoor tomatoes and the best varieties for each. The choice of varieties was based on information obtained from growers and County Officers who provided lists of varieties grown successfully in the open prior to 1941. Those selected were Market King or Plumpton King, Potentate, E.S.1, Stonor's Exhibition and Stonor's Prolific.

The results in lbs. per plant are detailed in the following Table 3. So far as is known the plants set out in the open ground were taken from size 60 pots, except in the counties marked A., which were from size 48 or 32 pots, and those marked B. from boxes.

Manurial trials.

Manurial trials also in the form of a twenty-five plot Latin square were arranged in seven English counties.

The treatments were:—

(*a*) Complete artificials with horse manure.

(*b*) Horse manure only.

(*c*) Complete artificials only.

(*d*) No fertilizers.

Horse manure was applied at the rate of 15 tons per acre. The complete artificials consisted of 5 cwts. per acre each of hoof and horn meal, bone meal, and sulphate of potash.

In series (*a*), (*b*), (*c*) the treatments were applied before planting. There were no top-dressings.

(*e*) Neither manure nor artificial mixture was applied before planting, but there were three top-dressings each at the rate of 5 cwts. per acre, consisting of a mixture of one part sulphate of ammonia, one part sulphate of potash, and three parts 30% superphosphate.

The results are given in Table 4.

The results of all trials were discussed at a meeting attended by twenty-four County Organisers, held at the Ministry of Agriculture in London on 3rd March, 1942.

The following conclusions were agreed as the result of the trials held in 1941:—

1. Tomatoes can be grown in the open in all parts of England and Wales, but low yields are to be expected in North Wales and the extreme North of England.

2. The heaviest crop, grown in Middlesex, was 8·5 lbs. per plant (36·6 tons per acre) from E.S.1. The lowest yield, grown in Cumberland, was 1·3 lbs. per plant (5·6 tons per acre), also from E.S.1.

Table 3. Results of varieties trials, in pounds per plant.

A—Planted from size 32 or 48 pots.
B—Planted from boxes.

COUNTY		Market King or Plumpton King					Potentate				E.S.I.				Exhibition				Prolific			
		Total		Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking
		Market King	Plumpton King																			
MIDDLESEX (1)	A	8·3	—	6·9	—	—	7·2	6·4	—	—	8·5	6·9	—	—	8·3	6·9	—	—	7·3	6·3	—	—
															Grade		well		Money maker			
SOMERSET (2)	B	—	6·6	4·0	—	—	6·1	3·2	—	—	7·2	4·4	—	—	4·6	2·7	—	—	6·3	3·4	—	—
BUCKS (1)	...	6·5	—	5·9	3·3	26/8	6·4	5·3	2·0	21/8	5·6	4·8	2·1	21/8	6·0	5·0	1·7	21/8	5·3	4·8	2·5	21/8
																				Sunrise		
SURREY	...	—	6·3	4·3	—	—	—	6·1	3·5	—	—	5·6	3·1	—	—	6·8	3·5	—	—	6·8	3·5	—
																				Progress		
WEST SUSSEX	...	—	5·7	4·9	—	22/8	5·2	4·2	—	22/8	4·8	3·8	—	22/8	5·4	4·3	—	22/8	5·2	4·3	—	22/8
															M.P.					Best of all		
MIDDLESEX (2)	...	—	5·5	—	—	—	4·3	—	—	—	5·1	—	—	—	4·6	—	—	—	5·6	—	—	—
																				X-Ray		
KENT	...	5·2	—	4·0	3·3	—	4·4	3·6	2·9	—	5·2	3·2	2·4	—	4·6	3·6	2·8	—	5·4	4·5	3·5	—
CORNWALL	...	5·1	—	—	4·0	15/8	4·3	—	2·9	15/8	5·1	—	4·2	15/8	4·8	—	3·7	15/8	4·2	—	3·1	15/8
ESSEX	...	—	5·0	—	—	1/9	4·9	—	—	1/9	4·4	—	—	1/9	6·0	—	—	1/9	5·0	—	—	1/9
DERBYSHIRE	A	—	5·0	4·2	—	18/8	5·0	4·3	—	18/8	5·0	4·2	—	18/8	5·2	4·3	—	18/8	4·2	3·6	—	18/8
YORKSHIRE (EAST RIDING)	...	—	4·5	1·1	0·6	3/9	4·4	0·6	0·3	10/9	4·1	0·8	0·6	27/8	4·2	0·6	0·5	17/9	3·4	1·1	0·8	27/8
WORCESTERSHIRE	...	—	4·4	2·0	—	27/8	4·4	1·8	—	27/8	4·0	1·3	—	27/8	4·7	1·3	—	27/8	3·8	1·6	—	27/8
CHESHIRE	...	—	4·4	1·7	—	25/8	4·6	1·9	—	18/8	4·4	1·2	—	25/8	4·8	1·3	—	18/8	4·3	1·4	—	25/8
NOTTINGHAMSHIRE (2)	...	—	4·3	3·4	1·8	11/8	4·2	3·4	1·9	14/8	4·6	3·4	1·7	7/8	4·5	3·2	1·5	11/8	5·0	3·7	1·9	7/8
																Hundredfold				Best of All		
WARWICKSHIRE	B	—	4·4	—	—	21/8	4·0	—	—	21/8	4·2	—	—	11/8	3·5	—	—	21/8	4·0	—	—	11/8
																				Money maker		
BUCKS (2)	...	4·2	—	3·3	2·3	18/8	4·8	4·4	2·5	18/8	3·8	3·1	1·7	18/8	4·0	3·7	2·1	18/8	4·0	3·6	1·9	18/8
LEICESTERSHIRE	...	—	4·1	—	2·1	—	3·8	—	1·4	—	3·4	—	1·6	—	3·5	—	1·3	—	3·0	—	1·3	—
NORTHUMBERLAND	Part B	4·0	—	0·6	—	10/9	4·7	0·8	—	10/9	4·6	0·5	—	10/9	4·8	0·4	—	10/9	3·7	0·6	—	10/9
HUNTINGDON	...	—	3·9	—	3·1	25/8	3·6	—	3·4	25/8	4·4	—	3·3	25/8	2·7	—	2·4	25/8	3·4	—	2·8	25/8
ISLE OF WIGHT	...	—	3·3	—	—	28/7	3·1	—	—	28/7	2·9	—	—	28/7	3·0	—	—	28/7	3·0	—	—	28/7
NORTHAMPTON	...	3·3	—	2·9	2·2	3/9	2·8	2·1	1·4	3/9	2·7	2·1	1·6	3/9	2·2	1·4	1·2	3/9	2·4	1·7	1·3	3/9

Table 3 *(continued).*

A—Planted from size 32 or 48 pots.
B—Planted from boxes.

COUNTY		Market King or Plumpton King					Potentate				E.S.I.				Exhibition				Prolific			
		Total		Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking	Total	Ripe	Total to Sept. 30th	Date of first picking
		Market King	Plumpton King																			
DORSET		—	3·2	—	—	—	3·2	—	—	—	3·5	—	—	—	2·6	—	—	—	Monemaker 3·0	—	—	—
HERTFORDSHIRE		—	3·2	3·1	—	—	3·2	3·0	—	—	3·2	3·1	—	—	3·3	Radio 3·2	—	—	2·6	2·5	—	—
EAST SUSSEX		—	3·1	1·9	—	18/8	3·0	2·0	—	1/9	2·6	1·2	—	5/8	2·9	1·7	—	1/9	2·7	1·5	—	1·9
NOTTINGHAMSHIRE (1)		—	3·0	—	1·7	7/8	2·5	—	1·9	7/8	2·4	—	1·5	7/8	2·5	—	1·5	7/8	2·6	—	1·5	7/8
ANGLESEY		—	2·9	2·6	—	—	3·3	3·0	—	—	2·4	2·2	—	—	—	—	—	—	—	—	—	—
WEST NORFOLK		2·8	—	0·4	—	14/8	4·3	0·8	—	14/8	2·8	0·4	—	14/8	4·2	0·6	—	14/8	2·8	0·2	—	14/8
CAMBRIDGESHIRE		—	—	—	—	—	—	—	—	—	4·8	Kondail 2·8	—	—	3·8	2·0	—	—	Money 4·4	Money 2·4	maker —	er —
CAERNARVONSHIRE		—	2·7	0·9	—	15/9	4·6	1·5	—	15/9	2·2	0·7	—	15/9	—	—	—	—	—	—	—	—
DEVONSHIRE	A	—	4·3	4·0	2·2	11/8	3·9	3·1	1·8	11/8	3·8	3·6	1·8	11/8	3·9	3·5	1·5	11/8	4·1	3·7	1·7	11/8
DENBIGHSHIRE		—	2·4	1·5	—	—	3·9	2·4	—	—	—	—	—	—	2·0	Radio 1·3	—	—	Grade 2 3	well 1·4	—	—
LINCOLNSHIRE (KIRTON)		—	2·4	1·4	0·9	12/9	2·2	1·3	0·9	12/9	2·2	1·1	0·7	12/9	2·1	1·0	0·6	12/9	1·6	1·1	0·7	12/9
MONMOUTHSHIRE	B	—	2·2	—	—	10/9	2·6	—	—	10/9	2·3	—	—	10/9	2·4	—	—	10/9	2·3	—	—	10/9
STAFFORDSHIRE		—	2·1	—	—	—	3·1	—	—	—	2·1	—	—	—	2·8	—	—	—	1·6	—	—	—
MONTGOMERYSHIRE (1)		—	2·0	—	1·4	18/9	2·9	—	2·3	18/9	1·9	—	1·5	18/9	1·9	Radio —	1·4	18/9	Open-Air 1·4	—	1·0	18/9
BEDFORDSHIRE		—	2·0	1·4	—	5/8	1·5	0·8	—	5/8	2·5	1·7	—	5/8	2·9	1·6	—	5/8	Money 2·4	1·4	maker —	er 5/8
LANCASHIRE		—	1·9	—	1·0	27/8	1·8	—	1·2	14/8	2·4	—	1·2	27/8	2·2	—	1·2	27/8	1·6	—	1·1	27/8
SOMERSET (1)	B	4·0	—	2·2	—	2/9	3·7	2·2	—	2/9	3·7	1·9	—	2/9	Grade 3·5	well 1·9	—	2/9	Monemaker 4·1	2·4	—	2/9
CUMBERLAND and WESTMORLAND	A	—	1·9	1·8	—	18/7	1·7	1·7	—	23/7	1·3	1·1	—	18/7	1·8	1·7	—	1/8	—	—	—	—
MONTGOMERYSHIRE (2)		—	1·8	1·2	—	—	2·9	2·3	—	—	2·0	1·6	—	—	1·9	Radio 1·4	—	—	Open-Air 1·4	1·0	—	—
FLINTSHIRE		1·6	—	—	—	—	2·0	—	—	—	1·6	—	—	—	—	—	—	—	Woodward's 1·5	—	—	S.D. —
LINCOLNSHIRE (LINDSEY)		—	3·2	1·0	—	10/9	3·2	1·2	—	10/9	2·4	0·8	—	10/9	3·0	0·8	—	10 9	2·8	0·6	—	10/9

Table 4.

Result of manurial trials, in pounds per plant.

County	Variety	Complete artificials with horse manure			Horse manure only			Complete artificials only			No fertilizers			Top dressing		
		Total yield	Ripe	Ripe to Sept. 30th	Total yield	Ripe	Ripe to Sept. 30th	Total yield	Ripe	Ripe to Sept. 30th	Total yield	Ripe	Ripe to Sept. 30th	Total yield	Ripe	Ripe to Sept. 30th
KENT	Market King	5·70	4·76	3·44	5·33	4·08	2·88	5·37	4·59	3·30	5·33	4·28	3·10	4·89	3·97	2·84
ESSEX	Market King	5·27	—	4·00	5·21	—	3·86	4·10	—	3·48	3·89	—	2·94	4·19	—	2·91
YORKS (E. RIDING) ...	Market King	4·14	1·93	—	4·20	2·10	—	3·98	2·16	—	4·43	2·18	—	4·49	2·16	—
LANCASHIRE	Potentate ...	3·82	—	2·00	3·92	—	1·80	3·44	—	1·91	2·76	—	1·57	2·70	—	1·63
HERTFORDSHIRE ...	Radio... ...	3·09	—	—	2·71	—	—	3·09	—	—	2·54	—	—	2·78	—	—

3. The figures supplied indicate that pickings of ripe fruit were as follows:—

(A) 4 LBS. PER PLANT AND ABOVE.

Middlesex.	Buckinghamshire.	West Sussex.
Surrey.	Derbyshire.	Somersetshire.
Kent.	Devon.	Cornwall.

(B) 3 TO 4 LBS. PER PLANT.

Nottinghamshire.	Huntingdon.	Hertfordshire.

(C) 2 TO 3 LBS. PER PLANT.

Worcestershire.	Leicestershire.	Northamptonshire.

4. The varieties Market King, Plumpton King, E.S.1, and Potentate proved to be suitable for outdoor cultivation and may be relied upon to produce heavy crops of good quality fruit. Potentate, however, is more suitable for the damper parts of the country and should not be grown in dry exposed positions. Stonor's Exhibition cropped well, but the skin is tender and the fruit was badly blemished in 1941.

5. Seeds should be sown during the last week in March when the plants are planted out from size 60 pots or boxes.

6. In the southern half of the country planting in the open may be carried out during the last week in May and the first week in June. In the northern half of the country planting should be delayed until the second week in June.

7. Crops sown at the beginning of March, potted into 60's and then into 32's before planting out at the end of May, have given good and earlier yields. The age and condition of the plant at planting time are important and plants should be hardened off in cold houses or cold frames.

8. Suitability of soil and site, and careful attention to crop management, are probably more important than the variety employed.

9. The manurial trials in 1941 shewed a substantial increase in yield from horse manure with a smaller increase from artificials.

Other experience suggests that stable manure should be used only on poorer soils, as on rich land it is inclined to give too much foliage and small fruit.

Our thanks are due to all County Officials who assisted in the trials and also Dr. E. M. Crowther and his colleagues of the Rothamsted Experimental Station who gave advice on planning the experiments and who very kindly examined the results statistically.

2. Lettuce.

1) Cheshunt Early Giant.

There is no longer any doubt in the minds of most growers that Cheshunt Early Giant lettuce raised at the Reseach Station in 1933 is the most suitable variety of lettuce for cultivation during the Autumn and Winter in heated glasshouses. Many of the most experienced lettuce growers had proved the truth of this statement for themselves long before the present war, but it required war-time conditions and the need for large quantities of home-grown lettuce to give Cheshunt Early Giant a real chance of proving its value. Now, after two seasons during which the cultivation of Winter lettuce in glasshouses has increased enormously the value of this variety is universally acknowledged. Indeed it is no exaggeration to say that had it not been for the pioneer work in glasshouse lettuce started at the Research Station in 1931 and which led to the production of Cheshunt Early Giant, the people of this country would have lacked the millions of tender, well-hearted heads of glasshouse lettuce which have been grown each Autumn and Winter since the present war began.

Good crops were marketed from the experimental houses as they have been each year since 1933.

Full details of cultivation will be found in the Station's Circular No. 9.

(2) Cheshunt Early Ball.

The investigations which led to the production of Cheshunt Early Giant also produced a smaller type, Cheshunt Early Ball, which is eminently suitable for cultivation either in cold frames or over hot beds, and which is not so widely known as its popular glasshouse relation, although it is becoming more popular each year.

It can be grown either as an Autumn or a Winter crop.

(a) Autumn Crop.

If seeds are sown in boxes in an unheated glasshouse early in August, the seedlings pricked off 5 to 7 days later, and the young plants kept growing under glass without any attempt at hardening off, they can be planted in cold frames during the first ten days of September. If the frames are kept closed (without ventilation) the crop can be cut in the Lea Valley about the middle of November.

(b) Winter Crop.

Seeds should be sown in boxes in a glasshouse at a temperature of 50°F. to 55°F. about the middle of December and the seedlings

pricked off 7 to 8 days later. At the beginning of January they should be stood out in cold houses for 7 to 10 days and then planted out about the middle of the month, if weather permits.

Alternatively, seeds can be sown very thinly in steep beds, covered with lights, about mid-October and allowed to remain there until planted out from the following mid-January onwards.

The following planting out and cutting dates have been recorded at Cheshunt.

Planted out.	*Crop Cut.*
14th January	23rd March.
12th February	2nd April.
17th March	14th April.

Cheshunt Early Ball can be planted out any time from 1st January to the third week in March and this variety is remarkable for the fact that it will stand for three weeks or more after it is ready without bolting.

Where plants have been planted out in frames at the middle of February, the lights can be removed early in April and the plants left exposed to the weather. Under these conditions they heart slowly and can be cut at the end of April, when good lettuce are often on short supply.

Seeds of both Cheshunt Early Giant and Cheshunt Early Ball lettuce are available for those who require them.

2. Advisory Work in War-time,

1. Worthing.

A. A. RICHARDS AND P. H. WILLIAMS.

During the period 21st April to 12th May, some 70 nurseries were visited in the area between Lancing and Fishbourne as well as in the Ashington and Thakeham districts. A few nurseries further afield in East Sussex and Hampshire were also included.

The tomato crops were well advanced, in most cases the third and fourth trusses being well set and promising.

Some of the earliest growers were already picking fairly heavily and in practically every case the variety was Potentate grown in small low houses and forced along under almost cucumber conditions.

Many growers were trying out small plots of Vetomold, usually in those houses where *Cladosporium* caused most trouble. Under the varied conditions of soils and temperatures this variety must have been tested thoroughly during 1941 and it will be interesting to know the growers' opinions of it.

More growers appear to be using the straw wall system to good effect, but it should be part of the annual routine on the heavier clays and silts, if the maximum yield is to be obtained. One can only assume that the extra labour needed for inserting the straw in the soil prevents its more general application.

Many growers have either grubbed their peach trees out or cut them back severely to make room for tomatoes, and fewer beans and mushrooms were seen.

Early grapes were well forward despite the cold weather. Some were colouring nicely and generally the main crop shewed great promise.

Forced strawberries, although good, were severely restricted in numbers and grown in conjunction with early tomatoes.

Outside ground was being prepared for tomato crops, and other areas normally filled with plants for the cut flower trade were mostly planted with onions.

So far as the disease situation was concerned it would appear that the virus diseases of the tomato are widespread in West Sussex. In about half the nurseries visited an appreciable degree of infection was noted. In about one-third of these, Streak was definitely present but in most cases the plants shewed the typical mosaic mottling. Four cases of Spotted Wilt were observed. In two of these chrysanthemums were probably the host on which it had overwintered, while dahlias and arums were implicated in the other two.

"Damping Off" of seedlings in pots was noted on two nurseries and on a third a very severe attack of foot rot in a newly planted house was traceable to infected potting soil, the plants having been infected before setting out.

Verticillium wilt did not appear to be general at the time of the visit, but one very bad attack was seen.

Leaf Mould, *Cladsoporium fulvum*, had already appeared on one or two nurseries. It was too early in the season to form an opinion of the value of Vetomold but some good reports of its behaviour last year were recorded.

So far as other crops were concerned, little disease was noted, beyond *Verticillium* wilt on cucumbers and Mosaic disease on Beans.

Our thanks and appreciation are due to Mr. F. W. Costin, Horticultural Superintendent for West Sussex, and to Mr. W. H. Young of Lancing, who gave us much valuable assistance in many ways.

2. Essex.

W. H. READ.

At the request of the Essex War Agricultural Executive Committee a comprehensive survey was made of the glasshouse nurseries in Essex.

Tomato crops were moderate but in many cases they were not so heavy as in 1940. This is mainly attributed to climatic conditions although it is regrettable that neglect had contributed in a few instances. Many nurserymen, fearing their plants would become unbalanced, withheld water from their tomatoes during the long dull period preceding the bright spell in June. Where the soil had not been thoroughly flooded during the winter this led to considerable drying out of the subsoil so that when the sudden, intensely hot spell arrived it was frequently impossible to supply the tomato plants with sufficient water with the result that they wilted badly, flowers failed to set and growth became thin and hard. These troubles were particularly noticeable with the variety Potentate for the fruit on the bottom trusses did not ripen at the usual time owing to the cold dull weather and tended to check the growth of the plants. Furthermore, watering and picking had to take precedence, with the result that red spider attacks became serious on many nurrseries.

The fungus *Verticillium albo-atrum*, responsible for what is known as "Sleepy Disease" of tomatoes, caused considerable trouble and it is probable that the cold, dull spring may have aggravated the attacks. Several nurserymen who were troubled by this disease in 1940 and who followed advice to sterilise their soil by steam-

ing or with formaldehyde, produced excellent, disease-free crops in 1941. The necessity for steaming thoroughly to rid tomato borders of this disease was stressed in the Annual Report for 1940 and it was interesting to observe two cases where the disease was serious after a quick and inefficient steaming of the ground.

Considerable loss was also caused by the fungus *Colletotrichum atramentarium*, especially where the soil had been inadequately prepared for tomatoes during the winter. In many cases it was associated with attack by "Damping Off" fungi *Phytophthora* spp. The need for using sterilised soil to ensure a clean start for tomatoes cannot be over-emphasised and it was surprising how many nurserymen were unaware that formaldehyde or other chemical sterilising agents could be used for this purpose.

Red spider mite was by far the most serious insect pest and few nurseries were free from it. The practice of buying in plants from infected nurseries has undoubtedly introduced the pest into nurseries which were free. Owing to the difficulty of obtaining suitable spraying equipment and the shortage of labour there has been considerable loss due to this mite.

Outdoor tomatoes were extensively grown, particularly in the south and east of the county where weather and soil conditions appear very suitable for this crop.

3. Blackpool.

A. A. RICHARDS AND P. H. WILLIAMS.

A short visit was made to Blackpool from 11th to 25th June. It was unfortunate that owing to pressure of work at the Station, it was not possible to stay longer in such an important glasshouse area but nevertheless useful information was gained as to the soil conditions and methods of cultivation in the West Lancashire area. We are greatly indebted to Mr. N. J. Macpherson, the Lancashire County Horticultural Adviser, who devoted several days to guiding us on visits to various parts of the county. Under his guidance visits were made to nurseries in the Ormskirk and Liverpool areas which would have been difficult to find without his help.

At the time of our visit many tomato growers had already shaded their houses, particularly on that type of soil known locally as "Black Moss" which has a tendency to produce a luxuriant growth in the early stages.

There appears to be three main types of soil in this part of West Lancashire. That nearest the coast in the lower lying parts known as the "Black Moss" is reclaimed peat land of great antiquity, light and spongy in texture and often of great depth but requiring

considerable skill in producing tomato crops under glass. The second type is a light clay or silt, heavily impregnated with sand, and situated a little further inland. The third, a much heavier clay, but containing much more sand, occurs on the higher lands, and becomes more general as one proceeds further inland.

All are capable of producing the valuable crops which have made Blackpool famous for its early vegetable and market gardening, particularly the early maturing crops of lettuce.

Most growers cultivate one or two crops of lettuce between September and March and some even extend its cultivation to May to make a third crop under glass.

Blackpool caters principally for the Midland markets where a yellow or light coloured lettuce is popular. "Golden Ball" and "Blackpool" are mostly grown in the autumn, but many growers are now growing "Cheshunt Early Giant" for the spring crop as with the higher light intensity it tends to lose some of its bright green colouring.

Tomatoes and lettuce are the two main crops, but many growers devote one house or space by the central pathways, for early-flowering sweet peas for which there appears to be a considerable demand in the Midland markets.

Sterilization of the soil, principally by steam, is an annual operation by many growers, particularly on the "Black Moss" soil.

Owing to the great difficulty of procuring stable manure no mushroom crops were seen, and only in one instance some miles inland were carnations seen. This grower is a noted exhibitor who has raised many new varieties.

Cucumbers are not an important crop locally, but it was interesting to find that where they were grown on the "Black Moss" raised beds were unnecessary. A good dressing of stable manure was dug into the borders, the plants set out in their permanent positions and occasionally a light dressing of stable-manure given but no attempt at raising the borders was made. The plants were very vigorous and carrying heavy crops of fruit.

In peace time much of the land was devoted to the cut flower trade, including "lifted" chrysanthemums, but with war-time conditions practically all was devoted to the production of salad crops and vegetables.

The disease most frequently noted was foot rot due to *Phytophthora* sp. while Leaf Mould, *Cladosporium fulvum* was also common. Virus diseases were noted throughout the area, the usual symptoms being mottling of the foliage.

The potato eelworm, *Heterodera rostochiensis*, was found on four nurseries, in one case the whole crop on a small nursery being infected. On another nursery where parts of two houses were infected, the grower has since informed us that the plants recovered later and bore a good crop.

4. Somerset.

O. B. ORCHARD.

During May, a short period was spent in Somerset at the invitation of the War Agricultural Executive Committee of that County. In the time available, it was not possible to visit every nursery in the county but the horticultural staff rendered invaluable assistance and selected nurseries where the growers were known to experience difficulties and those who have changed from flowers to food crops. Working in company with them it was possible to visit a large number of nurseries.

Glasshouse nurseries are scattered throughout the county, but the main areas are centred around Bath, Frome, Taunton and West Somerset.

In the Bath and Bristol districts, the majority of the glasshouse holdings are comparatively small and under normal conditions they produce large quantities of flowers for wreaths and the general flower trade, while the Frome district is well-known for the cultivation of chrysanthemums.

Under present conditions, all these growers are cultivating tomatoes, many of them for the first time. Many problems were encountered and discussed with the owners.

On many holdings the houses are very old and small, with awkward permanent staging, the soil is old and infertile through lack of cultivation and the heating systems are inadequate for early tomato crops. Consequently, even towards the end of May, many crops had only just been planted. The majority of the growers had cheerfully overcome their difficulties and were using every available piece of staging for pot tomatoes, but in spite of pressure on the part of the County War Agricultural Executive Committee it was observed that a few flower growers were still concentrating mainly on flower and bedding plant production to the detriment of the tomato crop.

Lateness of planting was frequently intentional on the part of a number of growers who had not appreciated that even moderately heated houses are capable of earlier cropping.

In the county there are many comparatively large glasshouse nurseries, and in the majority of them, very promising crops were being produced.

Throughout the County, soil types vary considerably, ranging from heavy clay loams to very light silts. Some of the nurseries have not been built on the most suitable types of soil for tomato cultivation, and in consequence many interesting problems in connection with dry subsoils and soils of low fertility were encountered. Very little winter flooding is practised and even at this early stage, many crops were already suffering from lack of water in the subsoil.

With the exception of one or two nurseries soil sterilization by steam is not the general practice, and where attempted it is usually by chemical means.

At the request of the County War Agricultural Executive Commitee growers in this county were visited again during late August and early September. The committee wished to know what steps if any, should be taken to increase the output of the tomato crops from the County for 1942. For this purpose the County Horticultural Advisory Officer selected randomised nurseries throughout the county, and in company with him these nurseries were visited to determine the condition of the crops towards the end of the growing season, and to ascertain the causes of failures which might have occurred.

Observations made during these visits suggested that although a number of heavy crops were produced, on the majority of nurseries, the crop yield was not as heavy as appeared probable during the early summer.

The falling-off of crop was more evident on nurseries and in houses normally employed for tomato cultivation, than on many nurseries where the houses were small and less suitable, and where failures might naturally be expected owing to soil conditions and low structures. In view of the lateness of planting on many nurseries, observed when visiting this county during May, it was disappointing to find that the tomato crop was almost at an end in numerous cases, for it was anticipated that cropping would continue extensively throughout the county until well into October.

Much of the low yields may be attributed to lack of cultural operations during the winter months, for many growers have not yet appreciated the importance of thorough flooding, digging and manuring the soil previous to planting.

Throughout the county attacks of tomato leaf mould (*Cladosporium fulvum*) caused severe loss of fruit from the " tops," which were frequently crippled through failure to control this disease. As the local weather conditions probably aggravate the severity of the disease growers are advised to concentrate on control measures as soon as the disease is evident. The importance of adopting control measures, and the existence of very efficient fungicides was not generally appreciated.

On several larger establishments, the tomato houses were shortly to be used for housing chrysanthemums, and in consequence the tomato crop had been neglected for the previous few weeks.

Throughout the county, no major root diseases are responsible for loss of crops, with the exception of a rather high proportion of the " Damping Off " and " Foot Rot " fungus during the early season. These were a source of serious loss to many growers who, unable to propagate their own plants, had to purchase from other nurseries. When purchasing plants, growers should make sure that they have been propagated and grown in sterilised soil and are free from root disease.

Many soils in houses which have turned over from flower production are very deficient in humus and very infertile. It is suggested that sterilisation with formaldehyde would greatly improve these soils, especially if adequately manured with stable manure.

As a result of the visit it was possible to assist the County Horticultural Officer to draft an advisory pamphlet dealing with the particular problems of the county. The authorities are to be congratulated on issuing this leaflet to all growers in time to carry out winter cultural operations.

In several parts of the county, very excellent crops of outdoor tomatoes were grown. Some of the sheltered slopes in the Bath and Cheddar districts are ideally situated for this crop. and exceptionally heavy crops of fine quality fruits were produced. In these particular areas, the extension of this crop should be encouraged, and although several well known varieties are grown, further experience may show that certain varieties are especially suitable for local climatic conditions. Late blight (*Phytophthora infestans*) caused serious damage to many large crops and it is suggested that during the coming season, growers should not wait for the appearance of the disease, but should commence spraying with a suitable fungicide during the last week in June. Spraying should be repeated at intervals of fourteen days and particulars of suitable fungicides may be obtained from the County Advisory Officer or the Director of this Station.

5. Norfolk.

O. B. ORCHARD.

During April a fortnight was spent with the growers in West Norfolk, where there is an extensive and modern glasshouse industry devoted to the production of food crops. In this district, the majority of the glasshouses are situated in the Terrington area. Many of the glasshouse holdings are comparatively small and are worked in conjunction with intensive outdoor market garden crops. Although under normal conditions many growers force bulbs, the tomato was the sole crop at the time of the visit.

A lecture was given at Terrington the subject being " Tomato Problems of the Marshland Area ". The attendance was good, and a very useful discussion followed the lecture. Almost all the nurseries in the district were visited and all visits were made in company with Mr. Gutsell, the County Advisor for the district. During the whole of the time spent in Norfolk, this Officer rendered every assistance and the nurseries visited were selected by him as being places where, in the main, advice might possibly be of value in increasing crop production.

The high standard of cultivation of the tomato crop was evident thoughout the area. A few growers deserve special mention in this connection, both for their earliness and general condition of their crops. Judged by the crops seen in this part of Norfolk it is obviously capable of producing well balanced and much earlier crops of tomatoes than the Lea Valley. This is largely due to the comparatively light soil which warms up quickly and to the prevailing light conditions. Although a number of very early crops were seen the general impression gained was that the majority of growers in this part of the County of Norfolk have not yet appreciated the possibilities of earlier cropping and thus tomato production has not yet become as important as it undoubtedly will once this fact is realised. It is probable that the tonnage per acre will never be as high as on some heavier types of soils but the earliness of the district would more than compensate for this when normal market conditions prevail.

Resoiling the glasshouses every few years is a common practice but with a few growers sterilization by steam is gradually replacing it.

There is little doubt that this established practice of resoiling glasshouses every few years is open to grave criticism because both pests and diseases are very liable to be introduced by this method. This applies especially in a district such as West Norfolk, where the fresh soil has been continually cropped intensively with other market garden crops.

Several severe attacks of wireworm, *Phytophthora*, *Fusarium*, and *Verticillium* were observed, and there is little doubt that in some cases, these pests and diseases were more serious after resoiling. This applies particularly to wireworm, a pest which is often very serious in this district.

As regards comparative costs, provided steaming is efficiently conducted, there is little to choose between the two operations, and whereas an increased crop is assured after steaming, as already pointed out, serious loss of crop may result through the introduction of pests or diseases after resoiling.

Opinions held by growers in this district on steaming methods were varied and often confusing. Several very efficient steam boiler installations were seen and it is suggested that the owners would render a national service in the present crisis by hiring out their boilers to neighbouring growers.

At the time of this visit very little disease was found amongst the crops. The variety Potentate is the chief tomato grown, and it appears to be very suitable for the prevailing soil and light conditions.

Finally all growers interviewed were very appreciative of any advice that would assist them in tomato production.

6. Cheshire and North Wales.

O. OWEN.

During the season over 140 nurseries in Cheshire and North Wales were visited at various times. It is again a pleasure to record that in all cases the County Horticultural Officers were most helpful and their co-operation was very much appreciated.

In general, growers in these counties, were as in other parts of the country, doing their best in support of the National Campaign to produce more food. The main complaint—and it was fairly widespread—concerned the difficulty of getting skilled labour ; in some districts labour of any sort was scarce.

As already reported most of the nurseries in the North Wales Counties are of the " mixed " type. This also applies to the nurseries in Cheshire where it was estimated that there are over 500 market gardeners with some glass. The main crops under glass are tomatoes and lettuce and in addition plants are raised for outdoor planting. All the better known varieties of tomatoes were seen with the exception of Potentate which is not so popular as the others. A wide range of forcing lettuce varieties was grown, the best crop seen being one of Cheshunt Early Ball grown under very low lights fitted over the pipes leading from boilers to the houses.

There is a tendency in many districts to start main tomato crops too early. Plants were seen frequently with a high first truss which had set badly. This may be due partly to the fact that many growers prick off the seedlings into deep boxes and pack the plants too closely together. As a result they become drawn, thin and pale and are not sufficiently robust when planted out. The chief cause of the failure, however, is the tendency for early planting. With the restricted sunshine in these areas it is doubtful whether, on the majority of nurseries there is any advantage in planting out before the end of March. This was amply borne out by the appearance of the plants and by comparison between crops planted at different times from mid-January to the end of March.

Apart from the tendency to plant too early there are one or two other points in tomato culture which deserve mention. Perhaps the most important of these is the use of water. Winter flooding, which is so important, is often neglected and more attention should be paid to this part of the winter work.

In some soils even after winter flooding the sub-soil dries out quickly and growers who are not already doing so would do well to try the straw method as advised in Circular No. 14. Not only does this method help to keep the sub-soil moist, but it also improves the soil physically in subsequent years. This practice with the judicious use of artificial fertilisers at the right time can make a wonderful difference to the "middle" of the plant which is too often a failure.

The other aspect of watering which is worthy of mention is overhead damping. On the whole, in the districts visited this practice is the exception rather than the rule.

With regard to diseases and pests it is a pleasure to report that only on one nursery was the Red Spider Mite seen: this was in a small house isolated from other nurseries. White fly occurred in several places and also the tomato moth caterpillar. On two nurseries the plants had been affected by Spotted Wilt and on one nursery tomato leaf mould, *Cladosporium*, had started by the middle of April.

The use of formaldehyde for sterilisation is growing in popularity but a word of caution may not be out of place. It is desirable that the grower should be certain that its use is necessary and having decided in the affirmative the process should be done properly. To apply too little at too great a dilution is useless.

Usually soil sterilisation is the alternative to resoiling. Which is to be preferred must depend on a variety of circumstances. Where turf is to be used for resoiling there is always the serious risk of plant injury from the wireworms it may contain. Further, soil or turf which has been stacked too long may become infertile so that special measures have to be adopted to render it fit for use.

7. Bedfordshire.

W. H. READ.

The glasshouse industry in Bedfordshire although small in comparison with the large glasshouse districts, is of considerable extent and was increasing rapidly before the war. With few exceptions the nurseries are situated on the light soils in the central and eastern parts of the county and on the chalk soils around Dunstable.

The warm light soil in the eastern part of the county is suitable for early tomatoes and many excellent crops were seen. It is the practice of several nurserymen in this district to grow two crops in the year. The methods employed conform with the best up-to date modern practice and soil sterilisation by steam or formaldehyde is frequently carried out. In general, crops in the Dunstable district were later. Many of the nurseries in this district are old and without doubt improved crops would be obtained if soil sterilisation was more frequently adopted. In the past this part of the county has specialised in high quality fruit rather than in maximum weight of crop whereas earliness and yield have been the object of most growers in the eastern part.

An early and very promising crop was seen on a nursery in the north of the county where the soil is very heavy ; it reflected much credit on the grower.

A visit was paid to the majority of the nurseries in May and a brief account of the problems and troubles encountered by the growers may be of interest.

"Damping off" of tomato seedlings was far too prevalent owing to the use of unsterilised soil for propagating purposes. Not only was there a high mortality of plants on many nurseries but specimens of planted out tomatoes which were making very poor growth, when examined by the mycologist in the laboratory, shewed that *Phytophthora cryptogea* the fungus causing " Damping off," was present. The importance of a clean start by the use of sterilised soil for propagating was repeatedly emphasised since plants with roots damaged by fungal attack cannot be expected to produce good lasting crops. In view of the absence of facilities for sterilising the soil by steaming or baking the most satisfactory method will be in the use of formaldehyde.

Verticillium wilt was responsible for severe loss of tomato plants on some nurseries but there were several bad losses through root rot caused by the fungus *Colletotrichum atramentarium*. There was evidence that this disease was contracted by tomatoes during propagation in at least two cases.

Mosaic disease of tomatoes was widespread but serious only on one nursery where it was accompanied by " streak." " Spotted wilt " was present on two nurseries where bedding and pot plants were being grown. On one of these the probable source of infection was a batch of dahlias, many of which were affected, and on the other pelargoniums and chrysanthemums.

Conversation with nurserymen in the Dunstable district disclosed that tomato leaf mould is serious on many nurseries later in the season. The fear of inducing mildew appeared responsible for the failure of some nurserymen to damp plants overhead so as to facilitate " setting " the bloom and in consequence there was considerable loss of fruit due to a " dry set ".

There were also bad attacks of White-fly in this district on several small nurseries, both on tomatoes and cucumbers and methods for controlling this pest were explained to the nurserymen concerned. The red-spider mite appears to be a pest on many nurseries in Bedfordshire but nurserymen are well acquainted with recent methods of control. Damage by other pests such as aphids, woodlice and millepedes was very slight.

Cultural difficulties were more in evidence. The preparation of the soil during the winter in readiness for cropping with tomatoes was frequently inadequate especially on smaller nurseries where the houses were cropped during the winter.

On several nurseries the subsoil was very dry due to lack of winter flooding, and owing to the nature of the soil there would be great difficulty in getting sufficient water down to this depth without the risk of damaging the upper roots by over-watering during the growing season. Undoubtedly many of the smaller growers have experienced difficulties in changing over from the propagation of bedding plants and flowers to tomatoes through lack of experience in the cultivation of early tomatoes.

Finally it must be placed on record that with very few exceptions the nurserymen visited were keen and appreciative of advice.

3. Plant Diseases.

1. Verticillium and Fusarium Wilts of the Tomato

P. H. WILLIAMS.

In the spring of 1941 seeds were received from Dr. J. W. Lesley of the University of California, of the American variety Riverside and of some unnamed selections from crosses between that variety and others. These varieties are resistant to the wilt diseases caused by *Verticillium albo-atrum* and *Fusarium bulbigenum* var. *lycopersici* in California and it was decided to test their resistance to these fungi under English conditions. The English varieties Ailsa Craig and Potentate (susceptible to both wilts) and Manx Marvel (reputedly resistant) were included in the test for purposes of comparison.

The seed was sown on 17th February. The plants were potted into 60's when ready and then into 9 in. pots in a tomato house on 16th April. They were inoculated by placing a portion of a plate culture of the appropriate fungus under the ball of each plant in direct contact with the roots. Sixteen plants of each variety were inoculated with each fungus and the plants were arranged in groups of four in randomised blocks so that the results could be examined statistically. It was decided to take the height to which the fungus penetrated the stem of the plants as a measure of susceptibility to attack.

A few plants died, the first on 24th July, They were mostly Potentate. Systematic examination of the plants was started on 12th August, isolations being made at 51 cm. intervals between soil level and a point above the highest point to which browning of the wood extended. Isolations were also made from plants in which no browning could be detected. Progress was slow mainly owing to interruptions caused by advisory work and the last plant was not examined until 21st October.

Verticillium was recovered from all the plants inoculated except one, shewing that the method of inoculation was satisfactory It is unnecessary to give the results in detail. Two of the unnamed selections, Nos. 40004-11 and 40005-17 proved to be significantly more resistant than American Riverside, Ailsa Craig, Potentate and Manx Marvel. American Riverside appeared to be the most susceptible although only slightly more so than Ailsa Craig. Manx Marvel was more resistant than Ailsa Craig but not significantly so.

Infection by *Fusarium* was uneven, probably due to the temperatures being too low for the disease and to loss of virulence by the fungus. No trustworthy conclusions can be drawn from the results of this experiment so far as this fungus is concerned.

The quality of the fruit produced by the American selections was inferior to English market standards. The plants, however, varied greatly in their fruiting characters, and selection would no doubt improve the quality of the fruit. Seed was saved from the best plants for future use. They may be useful in future breeding work, for the production of varieties resistant to *Verticillium* and *Fusarium* wilts is of great importance to growers in Great Britain and the Channel Islands.

2. Virus Diseases.

(a) The effect of lime and potash on the Spotted Wilt Virus disease of the Tomato.

I. W. SELMAN.

During the past two years, an attempt has been made to correlate the manurial content of soils with the symptoms exhibited by virus-infected plants grown in these soils. Using the methods proposed by Morgan (1935) for rapid soil analysis, it has been possible to assess the relative values of readily soluble minerals present. The importance of nitrogen, potash and lime in determining the severity of attack by virus diseases quickly became apparent, and an experiment was therefore carried out to investigate the effect of varying amounts of lime and potash on tomato plants inoculated with the Spotted Wilt virus.

The soil used was a medium clay loam, deficient in soluble potash and containing no free lime (pH 5.5—5.7). Dried blood and superphosphate were added to the soil and differential dressings of slaked lime and sulphate of potash were intimately mixed with it before potting. Four levels of lime were applied at the following rates per "60" pot : 0.0, 0.2, 0.6, and 1.8 grams. At each level of lime there were five levels of potash fertilisation thus : 0.0, 0.1, 0.3, 0.9, and 2.7 grams of sulphate of potash per "60" pot. Seedling tomato plants were potted in the soil on 18th April and when at the seven leaf stage, on 5th May, these were inoculated with Spotted Wilt virus by wiping muslin, soaked in infective juice on every leaf on the plant. There were 3 plants in each treatment making a total of 60 plants in all.

At the time of inoculation, all the plants were growing well, although slight differences in appearance were evident, due to the various fertilisers applied. The plants receiving the highest dressing of lime together with 0.0 or 0.1 grams. of potash were the most vigorous, being of a dark green colour and having a broad leaf span. Where lime had been omitted, or light dressings only applied, the plants were of a blue-green colour and leaf development was not quite so free as those of the other series.

Symptoms of infection commenced about 8 days after inoculation but both the nature of the symptoms and the length of the incubation period varied markedly with different manurial treatments. For simplicity the results will be considered in relation to lime and potash separately, although these elements were actually applied in varying combinations.

Effect of Lime.

In table 1 is shewn the number of plants shewing recognisable symptoms of infection. Fifteen plants were inoculated in each lime group, on 5th May.

Table 1.

Days after inoculation	No. of plants shewing symptoms.			
	Lime : 0.0 gm.	0.2 gm.	0.6 gm.	1.8 gm.
8	1	0	0	0
9	2	0	0	0
10	8	5	1	0
11	10	11	4	3
12	13	12	7	6
14	14	15	12	9
17	14	15	12	11
21	15	15	13	12

Thus the incubation period of the virus was markedly increased by the addition of lime, and, of the plants receiving the two highest dressings, 5 out of 30 failed to develop symptoms of infection, although kept under observation for several more weeks.

Symptoms of the disease were so variable, that the only ones observed constantly were reflexing of the leaves and some degree of stunting. Certain treatments tended to induce fairly well-defined symptoms, thus :

Lime 0.0 gm. (1.) Reflexing of the leaves was well defined.

(2.) Secondary spots appeared on the leaves, the former being black, chocolate or light brown in colour.

or A chocolate-coloured glazing appeared on the leaves.

(3.) The leaves tended to roll up, displaying the undersides of the veins, which were of a purple hue.

Lime 0.2 gm. (1.) Reflexing of the leaves generally occurred.

(2.) Light brown or chocolate coloured spots appeared on the leaves, but no black spots were produced.

or A general bronzed glazing appeared on the leaves.

or A few plants shewed local, necrotic primary lesions only.

(3.) Some plants shewed leaf roll symptoms.

Lime 0.6 gm. (1.) Reflexing of the leaves occurred.

(2.) There was a marked tendency for the production of severe lesions, which took the form of yellow, black or brown spots, or zoned brown spots, or of coalescing brown patches some of which resulted in the death of the leaf.

One plant only shewed glazed bronzing.

(3.) The tendency for leaf rolling was at a minimum in this group, only 3 plants out of 15 shewing this.

Lime 1.8 gm. (1.) Reflexing of the leaves was very slight, and difficult to detect in this group.

(2.) Few spots and lesions were produced, but those that did appear tended to have a more severe effect than in the low lime groups, frequently resulting in the death of individual leaves.

Bronzing did not usually occur.

(3.) Very slight leaf rolling was observed on 10 plants only in this group.

Spotted Wilt was first reported as a serious disease of the tomato in Australia. Samuel *et al* (1930), investigating the disease in that country, have given coloured plates of affected plants and these approximate closely in appearance to the plants which received no lime in the present experiment. The same author (1931) has stated that in South Australia most tomato growers do not use lime. It has been noticed that in England, on nurseries where growers apply 1 or 2 tons of lime per acre annually, Spotted Wilt disease rarely appears. Further work is necessary to ascertain the relative importance of these observations, but growers might profitably watch for any correlation between liming and the incidence and severity of Spotted Wilt on their own nurseries.

Effect of Potash.

The appearance of symptoms in plants receiving varying amounts of potash is indicated in Table 2. Twelve plants grown at each potash level were inoculated on 5th May.

Table 2.

Days after inoculation	No. of plants shewing symptoms.				
	K_2SO_4: 0.0 gm.	0.1 gm.	0.3gm.	0.9 gm.	2.7 gm.
8	0	0	1	0	0
9	0	0	2	0	0
10	3	3	5	1	2
11	6	5	7	5	5
12	8	5	9	7	9
14	9	8	11	10	12
17	9	10	11	10	12
21	10	12	11	10	12

There was thus little evidence of any important change in the length of the incubation period under varying potash levels, nor was the absence of symptoms from certain plants related to the amounts of potash supplied. Comparing tables 1 and 2 it will be seen that the plants receiving no lime and 0.3 gm. of sulphate of potash tended to develop symptoms most readily. Such a combination of lime and potash is not, of course, normally included in a potting soil for seedling tomatoes.

No consistent differences could be detected in the symptoms displayed at the various levels of potash fertilisation. It is however, of interest to record that two plants receiving 0.2 gm. lime plus 2.7 gm. of potash were showing brown stem streaks on 27th May in addition to a severe orange-brown leaf spotting.

Conclusion.

In view of the diverse symptom pictures which Spotted Wilt infection may induce in the tomato, it is clearly important to identify by biological tests all suspicious cases of disease that may appear on a nursery, so that appropriate control measures may be instigated. Preventable loss from Spotted Wilt infection on mixed nurseries was heavy in 1941.

Adequate liming of the loam soil investigated, tended to delay symptom appearance and also produced a proportion of plants which did not appear to be susceptible to artificial infection with Spotted Wilt virus.

No evidence was obtained to suggest that sulphate of potash was important in affecting either the nature of or the rate of appearance of Spotted Wilt symptoms, although in an unlimed soil medium potash fertilisation tended to facilitate symptom development.

References.

Morgan, M. F. (1935) Bull. 372 Conn. Agr. Exp. Sta.

Samuel, G. *et al* (1930) Bull. 44 Council for Sci. & Indust. Res. Melbourne.

————(1931) *Reprint from* J. Agric. of S. Australia. V. 34.

(b) The significance of Stem Stripes or Streaks in the Tomato.

Growers have long been familiar with the appearance of brown or black " blaze-marks " on the stems and leaf stalks of tomato plants, and this disorder is conventionally referred to as " Streak " or " Stripe " disease. It is not generally realised, however, that streaks are rarely symptoms of any one specific disease but may be associated with several widely differing causes. The presence of stem streaks should be regarded primarily as an indication that cultural conditions are at fault.

An unusual illustration of the importance of cultural conditions in this connection was noted in 1941, when tomato plants bearing one flower truss, were received from a nursery in Wiltshire. The leaves of these plants were turning yellow and severe light-brown stem lesions were present. Inoculation tests failed to shew the presence of a virus disease and Miss Oyler reported that pathogenic organisms were absent. Soil tests shewed that an adequate supply of lime, potash, nitrogen and phosphate was available, but the texture of the soil was found to be unsatisfactory. It consisted of a light, powdery material containing a little peat. When plants were potted in this soil in the usual way, drainage was extremely rapid, and drought symptoms were readily induced in the plants. By wetting the soil thoroughly before potting, and by packing it tightly into the base of the pot, it was possible to obtain excellent growth of tomatoes without further special treatment. In this case stem lesions were associated with alternate periods of high and low soil moisture content in a well-fertilised soil.

The following factors are now known to be associated directly or indirectly with the production of streaks : those common in commercial practice have been starred.

(1) Virus infection together with Faulty Cultural Conditions.

At least six of the common virus diseases in association with several environmental factors are now known to be conducive to the production of stem lesions thus :

*Tomato mosaic virus and Enation Mosaic Virus.

Tobacco mosaic virus

Yellow mosaic (Aucuba)

Spotted Wilt

Mixed potato and tomato viruses (usually causing death of the plant)

Temporary water shortage in porous, well fertilised soils.

*Mineral deficiency, especially shortage of potash.

Unbalanced fertilisers, e.g. excess potash or phosphate (Volk)

*High temperatures together with low light intensities. This condition is common in November in glasshouses, but is also important during warm, dull spells in the summer, if ventilation is inadequate.

(2) Bacterial Infection.

Infection with *B. lathryii* may induce streaks (Paine and Bewley).

(3) In plants free from pathogenic organisms or virus :—

(*a*) *Water shortage*, under the conditions described above, may induce streaks.

(*b*) *Potash deficiency*. Streaks of a brownish-purple colour are sometimes associated with this disorder according to Janssen and Bartholomew.

(*c*) *Toxic Chemicals* in the soil.
Owen (Ann, Rep. 1928) has found that low concentrations of potassium perchlorate or high concentrations of copper sulphate may lead to the production of brown streaks on the stem.

It is thus evident that it is not always possible to diagnose the correct treatment for streaked plants by inspection, although it is true to say that by far *the commonest cause of streak is a combination of tomato mosaic infection with faulty cultural methods.* Careful treatment of such plants will frequently lead to partial disappearance of the stem lesions and a fair crop of fruit can still be produced despite the loss of one or more trusses.

(c) Fruit losses associated with Mosaic Infection in the Tomato.

Work on the effect of Tomato mosaic viruses on crop plants described in this report for 1940 has been continued using the "severe mottle" strain only. The growth and fruiting of Potentate tomato plants inoculated with tomato mosaic virus when the first truss was in bloom, have been compared with plants infected when the fifth truss was in bloom. The results obtained with this virus for the two seasons have been compared and analysed. A fuller account will be published elsewhere but a summary of the results is given below.

(1.) In the two seasons, early infection consistently induced the following effects :—

(*a*) A significant reduction in the numbers of fruits produced.

(*b*) A small, non-significant reduction in average fruit weight.

(*c*) A significant reduction in the total yield of ripe fruit.

(*d*) An increase in the percentage, by weight, of blotchy fruit.

(2.) Early infection was *not* found to induce any reduction in the numbers of flower buds formed in 1941, nor in the number of leaves produced, and had no significant effect on the growth rate of the stem. The difference between these results and those reported earlier, was attributed to an increased supply of nitrogen to the young plants and to the maintenance of a higher atmospheric humidity and a greater soil moisture content.

(3.) The importance of the partial failure of the flowers to set fruit in the early infected plants in relation to final yield was evident in the very close correlation that existed between the yield of the individual trusses and the numbers of fruits maturing on each truss. Further work will be undertaken to determine the factors affecting fruit set in virus infected plants. There is some evidence that this effect is to some extent seasonal, being more severe on plants infected in the early spring than it is on plants infected in mid-summer.

(4.) The relative reduction in fruit yield due to early infection was reduced from 22.3% in 1940 to 13.4% in 1941. At the same time the absolute yields per plant were higher in both early and late infected plants in the second year, thus indicating that more careful attention to the cultural conditions will do much to reduce losses due to early infection with Tomato Mosaic virus.

4. Animal Pests.

1. Trapping the Tomato Moth. (*Polia oleracea* L.)

E. R. SPEYER AND W. J. PARR.

Experiments have been continued both at the research Station and upon commercial nurseries with a view to obtaining suitable attractants for trapping the moths in jars. During the previous season it had been established that cane molasses, mixed with cheap ale, provided an adequate substitute for treacle, the proportions recommended being ale 3 parts, cane molasses 1 part ,with sodium fluoride to the amount of 1% added as a poison. From 16 jars each containg 3 fluid ounces of this mixture, hung in the two propagating houses at Cheshunt over a period of 62 days from 29th January (when the first flight of moths started) to 5th April, 1941, 110 moths were collected, giving an average of nearly 7 moths per jar : the sexes were in nearly equal proportion. In the block of five low houses, (in which, over a period of 12 days at the end of March 1940, only 5 moths had been trapped in 24 jars containing ale and treacle), 26 moths were caught in 18 jars containing the new bait over the corresponding period in 1941.

In houses on two commercial nurseries over a period of 18 days in April 1941, seven jars containing this bait caught 29 moths, and during the following 12 days the number of moths trapped rose to over 8 per jar. Early in the year, cane molasses was rationed, and though growers were granted permits to obtain supplies, it was thought desirable to obtain an unrationed substitute.

The odour of cane molasses suggested an investigation into the products of malting, and preliminary observations with a few jars hung in tomato houses over a period of 26 days during April shewed that as many moths (4 per jar) were caught with ' Malt Extract ' as with cane molasses. Similar results were obtained in a block of six houses (each 250′ × 27′) in which 4 jars of each were hung at the ends of the two outside houses over a period of 16 days : those containing the bait made with malt extract caught 6 male and 13 female moths, those with the cane molassas 8 males and 7 females.

" Liquor of Malt " (containing 10% alcohol) and " Wort " did not prove attractive to the moths.

In experiments upon a larger scale, baits containing malt extract invariably attracted at least as many moths as those containing cane molasses. The sticky nature of malt extract made its use somewhat inconvenient in making up the bait, and the solid " Powdered Malt Extract " was found to give equally good results. It was found by experiment (see Table III) that the following bait was satisfactory :—

Ale 4 parts, Powdered Malt Extract 1 part, Sodium fluoride equivalent to 1%.

For mixing on a larger scale :—

Ale 1 gallon, Powdered Malt Extract 3½ lbs., Sodium fluoride 2 ounces.

Into each jar 3 fluid ounces of the mixture is introduced.

During August and September, over a period of 30 days, twelve jars were hung in a block of 5 houses, each 100′ × 26′, at the Experimental Station: 5 male and 23 female moths were trapped, an average, satisfactory for this time of year, of over 2 moths per jar.

The Station is greatly indebted to Messrs. Allen and Hanburys for so generously supplying very adequate material for the investigation.

It was suggested that further trials should be made with beet molasses and that cider which has been used in baits for other moths should be tested as a substitute for ale. Table I shews the results obtained in a block of two commercial houses (each 220′ × 35′) in which the position of the jars, each containing 3 fluid ounces of bait, was changed on the 9th day of the first period of 18 days and every two days during the following period of 12 days. the whole period extending from 10th April to 10th May.

Table I.

Bait.	*Period Days.*	*No. of Jars*	*Moths caught.*			
			Male.	*F'male*	*Total*	*Per Jar.*
Ale 3 parts, Malt Extract 1 part.	18	6	9	22	31	5.2
Ale 3 parts, Cane Molasses 1 part	,,	3	3	11	14	4.7
Ale 2 parts, Beet Molasses 1 part	,,	6	9	15	24	4.0
Cider alone.	,,	6	8	8	16	2.7
Ale alone.	,,	3	1	3	4	1.3
Ale 3 parts, Malt Extract 1 part.	12	2	10	8	18	9.0
Ale 3 parts, Cane Molasses 1 part	,,	2	8	9	17	8.5
Ale 2 parts, Beet Molasses 1 part	,,	2	8	4	12	6.0

In a low isolated house, 70′ × 30′, for a period of 20 days from 15th April to 5th May, 7 jars, each containing 3 fluid ounces of each bait listed below were hung close together at the south-west corner :—

Table II.

Bait.	*Moths caught.*		
	Male.	*Female.*	*Total.*
Ale 3 parts, Malt Extract 1 part.	1	6	7
Ale 3 parts, Cane Molasses 1 part.	2	5	7
Cider 3 parts, Malt Extract 1 part.	2	4	6
Ale 2 parts, Beet Molasses 1 part.	1	3	4
Cider 2 parts, Beet Molasses 1 part.	1	1	2
Cider alone.	0	0	0
Ale alone.	0	0	0

It was concluded that no advantage was gained by substituting cider, which is more expensive, for Ale, and that although considerable numbers of moths were trapped with baits containing beet molasses, the latter substance was notably inferior to malt extract or cane molasses for the purpose.

In further experiments (see Table III) Malt extract to an amount of 4% in the bait was added to ale and beet molasses and the attractive qualities were considerably increased by the addition.

Baits of ale and saccharin, and ale and essence of Jargonelle Pear (used by moth-collectors) were unattractive to tomato moths.

To determine how much powdered malt extract should be incorporated in the bait, jars were hung in a commercial block of 3 houses, 220′ × 105′ from 6th May to 19th May a period of 13 days.

Table III

Bait.	*No. of Jars*	*Moths caught.*			
		Male	*Female*	*Total*	*Per Jar*
Ale 4 parts, Malt Extract 1 part. ..	1	2	5	7	7.0
Ale 10 parts, Malt Extract 1 part.	1	3	1	4	4.0
Ale 20 parts, Malt Extract 1 part. ..	1	0	1	1	1.0
Ale 2 parts, Beet Molasses 1 part Malt Extract 4%	2	4	5	9	4.5
Ale 2 parts, Beet Molasses 1 part. ..	2	0	2	2	1.0

There is some doubt as to whether much benefit is obtained from moth-trapping during periods of hot weather when doors and vents are kept open, From 23rd June to 7th July four jars were hung in the corridor of an experimental house in portions of which caterpillars had previously been plentiful; during the period 19 newly-emerged moths were liberated in the corridor, but only one was trapped upon the last day.

Upon commercial nurseries moths ceased to visit the jars after the third week in May, and at the Experimental Station hardly any were trapped from this time until the middle of August: after 12th September again none were caught.

Provided that lead arsenate spraying for caterpillars, and moth-trapping have been practiced earlier in the growing season, it is suggested that the latter method might be dispensed with after the beginning of June and be resorted to again from mid-August to mid-September.

Into a cage containing a tomato plant and two moth-jars, seven male and four female moths, newly emerged, were introduced between 3rd and 8th July. Except for 2 males and one female

which died upon the floor of the cage, possibly after having visited the baits, all the moths were trapped, and only 3 egg-masses were deposited upon the plant. Some moths may, therefore, deposit an egg-mass before visiting the baits, but this represents a very small proportion of the total number of eggs which would be laid in the absence of a poison-bait.

During the trapping experiments the number of moths caught in jars in different positions in the blocks of houses was recorded. Of a total of 245 moths, 31% were caught at the north, 48% at the south ends, 6% along the east and 15% along the west sides : of a total of 239 moths, 22% were caught in the east, and 78% in the west portions of the blocks. About equal numbers were trapped in the north and south halves.

While the jar at the south-west corner generally trapped more moths than any other, this was not invariably the case. Upon one commercial nursery equal numbers were caught at the south-west and north-west corners and upon another where the south-west portion was shaded by sheds, by far the greatest numbers were taken in the jar at the south-east corner.

It is therefore necessary to recommend that a fairly even distribution of moth jars be made throughout blocks of houses in addition to hanging one at each end of each house.

The results of experiments upon a commercial nursery appeared to shew that little advantage was gained by hanging more than 27 jars to the acre, but this number must be regarded as a minimum for efficacy. Lloyd computed the effective range of a bait jar to be about 40 ft. and recommended 60 jars to the acre. With reduced labour and increased costs of materials, this figure appears to be high, and from the results of two years trapping experiments, it is suggested that 36 jars be hung to the acre, as represented by a block of 8 houses, each 200′ × 30′, one jar at each end of each house, and two jars about 70 ft apart along the gutters of each house.

2. Red Spider-mite. (*Tetranychus telatius L.*)

E. R. SPEYER AND W. J. PARR.

Investigations into the possibility of introducing Selenium into tomato plants with a view to rendering them immune from attack have been continued.

Plants of the variety E.S.1 grown from seed soaked for 24 hours in solutions of sodium selenate ranging from 0.015% to 2% became infested with mites as severely as plants grown from untreated seed : rate of germination and subsequent growth was not affected by the treatment.

Germination of seed sown in prepared composts containing from 20 to 70 parts sodium selenate per million parts compost was not retarded, but during the 12 days following germination, plants in composts containing more than 50 p.p.m. shewed injury to the cotyledons and their rate of growth was much retarded. When transferred to size 60 pots containing untreated soil, the plants made complete recovery but subsequently shewed no immunity from mite attack.

Plants grown from seed extracted from the fruit of immunised plants in 1940 were severely attacked by the mite.

The soil of seed-boxes was saturated with solutions of sodium selenate so as to give calculated concentrations of 62 and 50 p.p.m. respectively when the plants had attained an average height of 2 inches. Five days after treatment, the plants shewed severe injury from which, however, they made recovery after a period of 3 weeks in untreated soil. These plants again were attacked by the mite as severely as untreated controls. It was concluded from the experiments that tomato plants were not immunised from attack by the mite when grown in soils containing selenium *before* transference to 60 size pots.

If selenium is introduced into the soil of pot plants in quantities sufficient to render them immune from attack, there is grave danger of the soil of tomato houses, in which the plants are grown on, eventually becoming unfit for production of a crop. apart from the risk of the fruit becoming contaminated so as to be unfit for consumption.

Trials with solutions of sodium tellurate, sodium thiosulphate, and tartar emetic gave no evidence that tomato plants could be immunised from attack when watered with solutions of these salts.

A spray consisting of 2 lbs. tartar emetic and 3 gallons glycerine to 100 gallons water, recently used in U.S.A. for the control of the mite on cucumber and carnation plants, gave a high percentage of mortality of the mite upon tomato plants, but caused severe injury to the foliage : when the tartar emetic content of the spray was reduced, injury to the foliage was no less severe, and many mites escaped destruction.

Owing to the uncertainty in results obtained by the burning of sulphur as a means of winter treatment of the mite in glasshouses, some small scale experiments were carried out to determine if the mortality obtained might be due to small quantities of sulphur vapour and not to sulphur dioxide.

Some fumigations in a practically air tight chamber of 10 cu. ft. capacity, extending over periods of 18-24 hours with initial temperatures ranging from 60°F to 66°F indicated that sulphur

volatilised at rates equivalent to from 1 oz. to 4 ozs. per 1,000 cubic feet space did not kill a higher percentage of mites hibernating upon tomato plants than sulphur dioxide, obtained by burning equivalent amounts of sulphur. At least 50% but not more than 80% of the mites were killed in all the fumigations.

With sulphur dioxide, complete mortality was obtained in one experiment when an amount of sulphur equivalent to $\frac{3}{4}$-lb. per 1,000 cubic feet space was burnt, but in another in which an amount equivalent to 1lb. was burnt, a small number of mites were not killed.

When sulphur was burnt at the rate of $2\frac{1}{2}$lbs. per 1,000 cubic feet space in an isolated and leaky glasshouse of 4,000 cubic feet capacity, only 86% of mites hibernating upon tomato plants, and a much smaller percentage of those contained in perforated boxes distributed about the house, were killed.

3. Wireworm Investigations.

E. R.. SPEYER AND W. J. PARR.

Experiments were carried out to determine if certain substances, applied in the form of a powder to the " dibbing " holes immediately prior to planting, would protect lettuce plants from attack by Agriotes larvae.

Calomel 4% dust, pure calomel powder, a mixture of 28 parts castor-meal and 1 part Paris green, Kaolin containing respectively 1% of a-naphthylamine and 1% allyl isothyocyanate, Derris, and Lonchocarpus powders, failed to afford any protection.

Kaolin containing 20% naphthalene caused plants to die off, and growth was retarded when only 10% naphthalene was contained in the mixture.

The following results were obtained from experiments to determine if certain substances mixed with soil would render the latter uninhabitable to the insects.

(*a*) Kaolin 80 parts, powdered naphthalene 20 parts.

Used at rates of 1 part up to 400 parts soil, wireworms introduced died within a period of 3 days: introduced 6 days after mixing the insects were unaffected.

(*b*) Lime 95 parts ground with 5 parts allyl isothycyanate.

Used at 1 part to 500 parts soil, wireworms introduced died within 24 hours.

Used at 1 part to 750 parts soil, complete mortality was not obtained until the 12th day after introduction.

Introduced into the soils 7 days after mixing, the insects were unaffected.

(*c*) Derris powder.

Used at 1 part up to 50 parts soil, complete mortality was not obtained until the 8th day after introduction.

Introduced into the soil 4 days after mixing 50% of the insects were alive 14 days after introduction.

Used at 1 part to 100 parts soil more than half the insects were alive on the 8th day.

(*d*) Lonchocarpus powder (pure ground root).

Used at 1 part up to 100 parts soil, the majority of wireworms introduced were dead upon the 8th day.

Introduced into the soil 8 days after mixing 40% of the insects were dead upon the 10th day.

Muriate of potash at a rate equivalent to 4 ounces and Ammonium carbonate at that equivalent to 8 ounces per square yard evenly distributed over the soil surface and well watered in did not kill any wireworms contained in the soil.

None of the substances tested retained their lethal propertics sufficiently long to warrant their use in control of these insects.

Some observations upon the habits of wireworms were recorded and experiments in trapping them with stalks of various vegetables, sliced carrots, buried in the soil, and with drills of germinating wheat were carried out from January to March in Northumberland glasshouses. Space does not allow of details being published here, but from the information obtained the following conclusions were drawn :—

(1) During the winter months larvae of Agriotes may live in the soil, even in the heaviest and stickiest clays, at depths of more than 2 feet. The depth to which they penetrate appears to be influenced more by moisture requirements than by temperature.

(2) Provided that the wireworm population of the soil is comparatively small, a considerable measure of protection from attack upon a winter lettuce crop can be obtained by trapping the insects with slices of carrot or split vegetable stalks sunk in the ground to a depth of 2-4 inches between the rows of plants.

Thickly sown drills of wheat, 2 to 3 inches broad and not more than 4ft apart are more effective in assembling wireworms than vegetable stalks or carrots. As there are indications that the insects, after feeding, abstain from taking food again for a considerable time, it becomes questionable as to whether it is necessary to lift the rows until the wheat has attained a height of at least 8 inches.

(3) In soils which contain large numbers of Agriotes larvae, trapping should be resorted to before lettuce or tomato plants are planted out, and during the period of trapping the soil should be kept moist and a minimum night temperature of 45°F or more should be maintained.

(4) Larvae of Athous, though attracted to vegetable baits and germinating wheat do not appear to attack lettuce or tomato plants.

(5) Annual attacks by wireworms after 3 successive years are possibly due in some cases to the insects entering the glasshouses from surrounding land by passing beneath the walls.

(6) Larvae of the Dipterous insect *Thereva*, known to be predatory upon wireworms, were found to feed upon larvae of Athous, and seldom if ever upon those of Agriotes.

4. Root-knot Eelworm (*Heterodera marioni* Cornu).

E. R. SPEYER AND W. J. PARR.

In continuation of previous observations made upon the effect of watering infested soil with potassium iodide at a concentration of 1 part in 2,400 parts water, Tomato plants between 9 inches and 11 inches in height were planted in 32 size pots containing a light clay soil collected from the vicinity of severely infested plants in November, 1940. In one series, infected soil was used, and in the other noduled material from old roots was buried in the soil.

Plants watered with 50 cc. (roughly equivalent to 50 gallons per 100 sq. yds. surface) of the solution soon after potting shewed yellowing of the lower foliage 6 days after treatment, and when a second application was made 18 days after the first, this foliage died off. These plants, however, made fair growth subsequently. Plants watered with 30 cc. (roughly equivalent to 30 gallons per 100 sq. yds) were similarly affected, but to a lesser degree.

When the roots were examined in March, 1941, eelworm nodules were numerous upon the main roots of the plants which received 50 cc. solution in the soil containing noduled material : upon those of the plants growing in infected soil not containing the latter, very few nodules were present.

The roots of plants which received 30 cc. solution were in the majority of cases free of nodules in the infested soil. but in that containing noduled material were very severely attacked by eelworm. Control plants in each series shewed severe infestation of both the main roots and rootlets. Similar plants were planted on 10th December in a large box containing loam in which noduled material from old plant-roots had been buried 10 days before application of the solution

at a rate equivalent to 30 gallons to 100 sq. yds. surface : a second application was made 14 days after the first, in conformity with the treatment reported to be successful in controlling the pest upon light soils. The plants shewed no sign of injury from either application. Examined in the following March, only a few plants had a negligible number of nodules upon the roots, but those of a control plant were also only slightly infested.

It is therefore possible that the solution should be applied at a rate greater than 30 gallons per 100 sq. yds on heavier soils in order to obtain control of the pest.

5. Notes on Other Pests.

E. R. SPEYER AND W. J. PARR.

(a) Ghost Swift Moth. (*Hepialus lupulinus L*)

Sudden wilting and subsequent death of Chrysanthemum plants upon a commercial nursery in Hertfordshire was caused by caterpillars ringing the stems at ground level. In previous years plants had been lost in spring not long after re-potting in soil taken from grassland heavily infested with caterpillars,and again when housed in Autumn after the final potting.

Caterpillars placed in soil containing 1 part naphthalene to 1,200 parts soil were killed within 4 days. It was recommended that naphthalene should be mixed with the potting soil at the rate of $1\frac{1}{2}$ ounces to 1 cwt. soil, but it appears that control of the pest has been obtained by sprinkling from time to time small quantities of naphthalene over the soil of the pots.

Caterpillars were numerous beneath turf in the north of England and were not killed or rendered inactive by exposure to some 35° of frost experienced in January—in Hertfordshire they pupated towards the end of May and moths emerged from the chrysalids in June.

(b) Green-fly (*Aphididae*)

A study of the Aphids which infect tomato and lettuce plants grown under glass shewed that the most prevalent pests of both are *Macrosiphum solani* Kalt. and *Myzus ornatus* Laing. While *M. persicae* is common upon lettuce and carnation, this species does not appear to favour the tomato plant, and *Nasonovia ribicola* Kalt confines itself to the lettuce. Infestation of young tomato plants by *Myzus circumflexus* Buckt. was traced to previous attacks upon primula and arum. *Macrosiphum solanifolii* Ashm. (? = gei Koch) appears to be a minor pest of lettuce and tomato, but a very severe infestation upon the latter plant was recorded in Hertfordshire in September. All the species which are prevalent on tomato cause orange spots to appear upon the lower foliage, and *M. solani* Kalt also caused large dark spots on swelling fruits upon a nursery in Norfolk.

(c) **Thrip** (*Thysanoptera*)

The Rose Thrip (T. fuscipennis Hal.) was recorded as causing severe injury to the foliage and fruit of Peach upon a Sussex nursery. A technical paper upon the larvae of *Thysanoptera* has been published in the Transactions of the Royal Entomological Society.

5. Soil treatment with Carbon Disulphide, and Formaldehyde-Carbon Disulphide Mixtures for the Control of Wireworms.

W. H. READ.

Some small experiments made in 1939 shewed that it might be possible to destroy wireworms in tomato houses by drenching the soil with dilute carbon disulphide emulsions. A number of larger scale tests were therefore made during the present season both with carbon disulphide emulsions and a mixture of formaldehyde and carbon disulphide emulsion.

Tomato borders were well-dug and wireworms, collected in carrot baits from a nursery where wireworms were present in large numbers,were inserted in the soil at various depths up to a maximum of ten inches at the rate of approximately 200 per square yard. An emulsion containing 50% of carbon disulphide was used in these experiments. The soil was moist both when the wireworms were inserted and when the drench was applied. The temperature of the soil fluctuated between 57°F. and 61°F. at a depth of 6 in. during the period of the experiments.

Treatment of Plots and Results.

Plot 1. Ground dug 13th February, 1941, and wire worms inserted in the soil 19th February, 1941.

Drench containing one fluid ounce of emulsion per gallon applied at the rate of 10 gallons per sq. yd. 22nd February, 1941.

Planted with tomatoes 23rd February, 1941, and these plants were removed 27th February, 1941. Their roots on examination shewed no sign of wireworm injury.

Replanted with tomatoes 27th February 1941 and carrot baits inserted in the soil between the plants.

No wireworm were found at the pieces of carrot used as baits or at the roots of the plants when an examination was made on 12th March. The second batch of tomato plants grew normally and without any noticeable check.

Plot 2. Ground dug 1st March, 1941, and wireworms inserted in holes about 1ft deep 11th March 1941. Pieces of carrot were placed in some of the holes to induce some wireworms to remain at this depth.

Drench containing 1 fluid ounce of emulsion per gallon applied 14th March, 1941, at the rate of 10 gallons per sq. yd. Tomatoes planted out 15th March. 1941, and pieces of carrot inserted in the ground between them to act as baits. The carrots were periodically examined for wireworms over a period of three weeks but none were found. The plants grew away normally and their roots were free from wireworm injury when examined at the end of the season.

Plot 3. This was treated as was plot 2 except that the drench was half the strength, that is $\frac{1}{2}$ fluid ounce emulsion per gallon. There was no difference in the reults obtained when compared with plot 2.

Plot 4. This plot served as a control with which to compare plots 2 and 3. No soil drench was given but tomato plants were planted and carrot baits inserted as in plots 2 and 3. Almost every tomato plant was destroyed or severely injured by wireworms and very many wireworms fed on the carrot baits.

Plot 5. This plot was dug and wireworms inserted as in plot 2. Ten gallons per square yard of the solution obtained by diluting one gallon of 40% formaldehyde with 49 gallons of water were applied on 3rd April.

Some live wireworms were found in this plot several days later together with a few dead wireworms. When a search was made for wireworms on the 16th April only 10 live and 3 dead insects were found, although a careful search was made to a depth of two feet.

The tomatoes planted in the ground on 21st April were not attacked and examination of their roots at the end of the season shewed sign of wireworm injury on one plant only.

Plot 6. A drench consisting of a 1 in 100 dilution of 40% formaldehyde to which carbon disulphide emulsion had been added at the rate of $\frac{1}{2}$ fluid ounce per gallon was applied to this plot at the rate of 10 gallons per sq. yd. In other respects this plot was treated as plot 5. No live wireworms were found after treatment but careful examination of the soil to a depth of two feet disclosed only a very small number of dead wireworms compared with the number known to have been present when the soil was treated. Tomatoes grown in this soil grew very well and had clean undamaged roots at the end of the season.

In view of the failure to find many wireworms either dead or alive in plots 5 and 6 the results of these experiments cannot be regarded as satisfactory. The loss of plants in plot 4 and freedom from loss in plots 2 and 3 which were planted with tomatoes at the same time, did, however, shew that treatment with carbon disulphide had a decided effect in reducing the damage to plants. It was also shewn that formaldehyde, applied at the standard rate recommended for soil sterilisation, did not give complete control of wireworms. The disappearance of so many wireworms has not been explained for the absence of damage to plants in adjoining houses suggests they were not driven from the treated plots.

It will therefore be necessary to continue these tests under varying circumstances before any recommendation can be made.

General.

Many samples of insecticides and fungicides, including soil sterilising fluids have been subjected to trial. There has been a considerable increase in the number of samples of formaldehyde submitted for analysis. Growers are reminded that formaldehyde should always be stored in the warm whenever possible since the rate of polymerisation, i.e., the formation of white, gelatinous solids ; increases at low temperatures. Formaldehyde is an important raw material of munitions and in view of the shortage of supplies, care should be taken to avoid spoilage.

5. Chemical Problems.

A number of soil samples submitted for examination during the year were from glasshouses scheduled for tomatoes and which had been used for other crops for many years. Others had failed to give satisfactory crops. The chemical analyses of these samples shewed considerable variation and often the chief matter for concern was the physical condition. In some cases there was some evidence of definite infertility. This has been overcome in some cases by applications of superphosphate. Physical improvement may often be effected by the addition of stable manure, peat or straw.

The remainder of the soils analysed were for routine examination and produced nothing in the way of general interest.

In view of the prevailing condition a fresh impetus has been given to the use of peat from deposits in Britain. There appear to be many such deposits in the country and a number of samples have been received from various localities for an opinion regarding their suitability for glasshouse work. From a chemical standpoint the greater majority have been suitable but a number have been criticised for their physical condition. Various physical and chemical methods have been tried as part of the attempt to classify peats according to their suitability.

The range of materials examined for suitability as fertilisers increases each year. Among them may be mentioned the following :—

Plant ashes, burnt seaweed, soot for potash, flue deposits and dusts, potash substitutes, casein trimmings, fur and felt trimmings, meat and bone meals, superphosphate, bone meal, bone flour, dried blood, sulphate of potash, nitrate of potash, nitrate of soda.

As has already been reported the pure potash content of plant ashes depends on three factors (1) the material burned ; (2) protection from the weather before burning ; and (3) protection from the weather after burning. It is satisfactory to report that in one case of plant ash, despite lack of protection from weather the sample contained over 5 per cent pure potash (K_2O). Several of the other products which were offered as potash substitutes containing amounts of pure potash ranging from 3.8 per cent upwards were considered suitable but one sample was condemned as it produced injurious effects on tomato plants.

The fertilisers mentioned above were usually submitted for identification by growers who had lost the labels or had reason to believe that the materials had been contaminated or had suffered some adulteration in store.

It may be worthy of note that with new products chemical analysis is not sufficient. Unless satisfactory evidence is available it is always advisable to have them tested on growing plants. In this connection it should be remembered that plant ash is usually safe to use and if tomato trimmings, etc., are burned with the precaution stated above they are quite rich in potash and also contain some phosphoric acid.

Several cases of suspected chlorate injury have been dealt with but only in one case was there positive evidence to shew that chlorates were the injurious factor. This occurred on a fairly large nursery and in a house carrying its first crop of tomatoes. The road alongside the house had been watered with chlorate weed-killer to destroy grass and weeds some two years previously. Previous crops had shewn no indications of injury possibly because they were resistant to chlorate or because insufficient had seeped through from outside. By June, 1941, however, there was a typical chlorate injury in the tomato foliage and laboratory examination confirmed the presence of chlorate.

The increasing use of sand in composts has been accompanied by an increase in the number of samples of sand suspected of causing damage. In no case, to date, has any sample been found harmful.

The experiments with muriate of potash and potash salts respectively as substitutes for sulphate of potash have been continued. The results have confirmed the earlier conclusion that for a time at all events muriate can replace sulphate but that potash salts cannot be recommended for use on tomatoes. It would appear that muriate may cause some damage if used in too great quantities at a time and it is best used in conjunction with other fertilisers.

Further experiments on the use of the synthetic vitamin B on plants confirm last year's conclusion that although germination is stimulated the effect is only a transient one and that when standard composts are used there appears to be but little advantage in using the vitamin.

APPENDIX A.

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APPENDIX B.

Manurial Treatment in Tomato Experiments.

(Except plots in Appendix C.)

(1) Lime.

All houses received ground caustic lime at the rate of 1 ton per acre.

(2) Stable Manure.

Stable manure at the rate of 15 tons per acre applied to all house except :— House 4, plots 1-3, 11 and 12 ; and house 10, plots 1 and 4.

(3) Base-dressing.

All houses received ½ ton hoof and horn, ½ ton bonemeal, and ½ ton sulphate of potash per acre except house 3, plots 2 and 4 ; house 4, plot 5 ; and house 5, plots 1, 2, 3, and 4 ; house 7, plots 2 and 4 ; house 8, plots 1 and 3 ; and house 9, plots 1 and 2, received ½ ton muriate of potash per acre instead of sulphate of potash.

(4) Top-dressing.

Sulphate of Potash—All houses received a first top-dressing of sulphate of potash at the rate of 5 cwts. per acre.

Fertilizer mixture.—All houses except plots 1, 2, 3, and 10, 11, and 12, house 4, received 5 cwts, per acre of the following mixture every fourteen days at discretion :—

3 parts sulphate of ammonia.
2 parts dried blood.
7 parts 30% superphosphate.
5 parts pure dissolved bones.
½ part bone flour.
2½ parts sulphate of potash.

All houses received three top-dressings of the following mixture at the rate of 5 cwts. per acre :—

1 part sulphate of ammonia.
1 part nitrate of potash.
3 parts superphosphate.
5 parts dried blood.

except the muriate of potash plots in houses 7, 8, and 9, where muriate of potash was given instead of sulphate of potash.

Appendix C.

Manures applied to Plots 1-3, and 10-12 in Tomato House 4.

Plot.	TITLE.	Base Manure in Lbs. per sq. yd.				* Top-dressing in Lbs. per sq. yd.			
		Lime.	Stable Manure.	Basic Slag.	Sulphate of Potash.	Super-phosphate	Sulph. of Ammonia.	Nitrate of Soda.	Sulph. of Potash.
1	Complete Artificials (I.) without Nitrogen	1.0	—	0.4	0.1	0.5	—	—	0.2
2	Unmanured	1 0	—	—	—	—	—	—	—
3	Complete Artificials	1.0	—	0.4	0.1	0.5	0.2	0.2	0.2
10	Complete Artificials with Dung	1 0	7	0.4	0.1	0.5	0.2	0.2	0.2
11	Complete Artificials without Phosphates	1.0	—	—	0.1	—	0.2	0.2	0.2
12	Complete Artificials without Potash	1.0	—	0.4	—	0.5	0.2	0.2	—

* The Top-dressing was applied in eight equal instalments.

Appendix D.

Dates of Cultural Operations, 1940—1941.

Crop.	Sown.	Potted into 60's.	Planted out in borders.	First Top Dressing.	First Fruit Picked.	Last Fruit Picked.
Tomatoes ...	Jan. 9 1941	Mar. 2 1941	April 1 1941	April 25 1941	May 26 1941	Nov. 14 1941

DIAGRAM SHEWING ARRANGEMENT OF EXPERIMENTAL PLOTS, 1941